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BULLETIN 2b

ELEMENTARY SCHOOL

SCIENCE

(Interim Edition)

GOVERNMENT OF ALBERTA
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SPECIAL NOTE

This interim edition of the elementary science course will be used on an experimental basis in selected classrooms during the 1955-56 school term. The following information is given to assist teachers and principals in using the program effectively on a trial basis. They are asked to suggest further changes and improvements by way of additions, deletions or revisions as a result of their experience with it. The main objective of the science subcommittee is to make this bulletin meet the needs of teachers in science. The constructive criticism which people who have experimented with the course can offer will assist greatly in making the final draft of this bulletin meet the expressed needs of teachers.

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FOREWORD

Why This Revision Was Considered

The present elementary science program as it appears in Bulletin 2 (Pages 99-103) has been in use since 1947. During the past few years, concern has been expressed by teachers and administrators as to how effectively science has contributed to the objectives of education in the elementary school. Realizing that regular evaluation is essential to any successful program, a science subcommittee was established late in 1952.

How This Interim Course Outline Was Developed

The elementary science subcommittee, composed of superintendents, supervisors, and teachers, was requested to carry out a survey of the elementary science program and report its findings to the Elementary Curriculum Committee. At the outset it was agreed that the revision would be in terms of what teachers felt they needed to help improve science instruction. Many classrooms were visited during the survey and the teachers were invited to criticize the present program and to suggest how it could be improved. In addition, recommendations from teacher committees in rural and urban areas have been most helpful. The various criticisms, suggestions and recommendations were tabulated by the subcommittee.

What Did The Survey Indicate?

Teachers have indicated that a new science outline should answer the following questions:

(1) Can the outline be revised to indicate more specifically the concepts to be developed at each grade level?

(2) What is the place of each of the following approaches in the teaching of elementary science:

  (a) integrated (with enterprise)
  (b) incidental (as opportunities present themselves)
  (c) parallel activities (separate periods)

(3) What use should be made of the experiments in elementary science,

  (a) by the teacher?
  (b) by the pupil?

(4) What equipment is necessary to carry on a suitable experimental program in science?

(5) How can local resources be used to best advantage?

(6) How can field trips be used to improve elementary science instruction?

(7) How can you get the most use out of a science corner?

(8) What place should elementary science readers and other references occupy in the science program?

(9) How can a teacher improve her background of knowledge of science and science teaching?

(10) How can science understandings be evaluated other than by testing factual information?

Distinctive Features of the Proposed Program

A definite effort has been made to provide teachers with concrete help in reference to the problems they have experienced. Techniques and procedures suggested in this bulletin are those which competent teachers have found to be successful.

The outline indicates in more detail the science concepts to be taught at each grade level. More attention has been given to the method of developing these concepts.

While the inclusion of grade level concepts has made the outline appear to be much longer, there has been practically no change in scope (what we teach). There has been a very slight change in sequence (the order in which items are taught).

The course is still organized under the three main headings, Living Things, Earth and the Universe, Energy and Machines, as this organization articulates with the junior and senior high school science programs.

THE OBJECTIVES OF ELEMENTARY SCIENCE

Generalizations

It seems that tradition urges us to always think in terms of the subject matter that children should learn in science. The subject matter of science IS important but not in the sense of memorizing the number of legs a giant water bug has, or the class of lever of which the wheelbarrow is an example, or the migration route of the Arctic tern. These facts assume scientific import only as they help children to interpret their environment. THE STUDY OF SCIENCE, THEN, SHOULD HELP GIRLS AND BOYS COME TO KNOW SOME GENERALIZATIONS OR SCIENTIFIC PRINCIPLES WHICH THEY CAN USE IN SOLVING PROBLEMS IN THEIR ENVIRONMENT. This will involve practically all of the fundamental skills, reading to find out, writing to make records as well as involving skill in identifying problems, planning together and evaluating. It implies that teachers should do less telling and give children more assistance in finding solutions to problems. The children do build necessary science concepts if the teacher plans and arranges the necessary learning experiences. Concepts develop as the result of many and varied experiences.

Problem Solving

A second major contribution that the study of science should make is TO HELP CHILDREN GROW IN ABILITY TO SOLVE PROBLEMS. It is highly improbable that children become better problem solvers by filling in blanks in a workbook or by memorizing scientific facts. They must have practice in problem solving - in solving problems that have meaning to children, problems that are important to them. With this continued practice, the children learn there is a process in solving problems that brings reliable results. Let us not suppose that children do not have these problems; they encounter them in every-day experiences, they come upon them in their reading, they see other people experience them. The solving of problems, if properly done, will involve gathering materials, reading to find answers, seeing experiments performed, handling apparatus, doing experiments, planning interviews, devising ways and means, observing and checking results, and recording findings. Co-operative solution of problems will increase children's ability to work together. They learn to give and take both advice and criticism. Successfully solving a problem is always a satisfying experience.

Scientific Attitude

Elementary science SHOULD DEVELOP IN CHILDREN A SCIENTIFIC ATTITUDE. The development of this attitude resembles the development of problem solving ability in that teachers must do something about it. The mere practice of having pupils work with science apparatus, read good reference books and carry out many other activities does not guarantee the development of a scientific attitude. Children must be taught to continually ask themselves such questions as, "Do we know that?", "What proof have we?", "What do other books say about it?", "Should we try another experiment?" Science classes are the best place for this attitude to be taught although there is a place for this attitude in any classroom situation. Critical thinking is an important aspect of a scientific attitude. Children should be encouraged to question the reliability of sources of information, to be ready to accept new evidence if it is based on scientific findings, to realize there are no final conclusions in science. Developing a scientific attitude will provide many excellent opportunities for children to examine common superstitions and misconceptions. The finding of contradictory statements in books may help children develop a scientific attitude - they realize there are differences among authorities. This should lead to the checking of the authority of sources.

Interest and Appreciation

Science should also CREATE IN CHILDREN AN INTEREST IN AND APPRECIATION OF THE WORLD IN WHICH THEY LIVE. The world is so full of wonders. The brilliance of the sunset, the green leaf manufacturing plant, the earth's water supply with its never-ending cycle, and the beauty that surrounds us must surely cause children to pause and wonder. The appreciation of these marvels is a very personal matter which each person acquires in his own way. This appreciation is not developed through lecturing but rather by giving each child an opportunity to discover, to see, to feel, to experience. Through satisfying experiences each child can develop for himself an appreciation appropriate to his own personality.

Store of Knowledge

We expect the science program TO PROVIDE PUPILS WITH AN EVER-INCREASING STORE OF SCIENTIFIC KNOWLEDGE. This involves the principle of expanding concepts. Children come to school with much first-hand experience in the world of science. Their science experiences in school should come from the world in which they live and should be continually expanding from year to year through Grades 1 - 12. Not everything concerning a phenomenon can be taught all at any one time. Children's readiness and interests do not develop in such a way as to make that practicable. If children say, "We studied about the sun last year, we know all that", teachers should find out what concepts they have developed and proceed from there.

In conclusion the teacher should remember to continually ask himself these questions: "In what way is this science experience contributing to the development of these children? What is my objective?"

Conservation

The present program recommends an increased emphasis on conservation. Conservation of our natural resources is essential to our survival. To conserve is to save and protect, to leave what we ourselves enjoy in such good condition that others may share the enjoyment. It is an expression of good manners to nature and to our fellow men, including those generations not yet born. In some areas of North America elementary science is called "Science and Conservation." This indicates its importance and the emphasis it receives. While we have not yet reached that stage in Alberta and Canada, the difference is in time only. Conservation is everybody's business.

Although many of the broad concepts of conservation and natural resources are difficult for elementary children, particularly in Division I, there is a definite need for a greater emphasis on conservation education. There are a number of very worthwhile concepts which the teacher can develop with elementary children. Among these are the following:

(1) an appreciation of man's dependence upon natural resources

(2) selfishness and ignorance can destroy our natural resources

(3) wise use of natural resources guarantees continual use and enjoyment of them

(4) careful planning can improve our natural resources

These concepts can be developed in elementary children by relating the program in conservation to the immediate environment. Direct contact and experience with actual situations will be more meaningful than a text book approach. A study of conservation can be related to wildlife, soil, forests, minerals, water and recreational facilities. The natural interests of children suggest that wildlife and recreational facilities are good starting points in the primary grades; the other resources present in the immediate vicinity will suggest what other aspects could be used to best advantage. As a result of direct contact and experiences with some aspects of conservation in the immediate environment the child will develop desirable attitudes of saving, preserving, caring for and making wise use of our natural resources. The development of these attitudes is the important contribution of conservation education in the elementary school.

This topic will provide an excellent opportunity for each school to plan a program based on the local situation. It also lends itself very well to the compilation of a resource unit to supply needed information to teachers.

THREE APPROACHES TO THE TEACHING OF SCIENCE

In the present instructional practice, there seem to be three approaches to the teaching of science: the integrated, the parallel activity and the incidental. No one of these can be considered the only approach; each has a place and serves as a complement to the other.

The integrated approach assumes that the major science learnings can be taught as part of the enterprise. This method allows for the development of a better understanding of relationships by the pupil. He becomes more aware of how science affects his home, his community and his environment. Many enterprises lend themselves well to the inclusion of science learnings. There is no purpose in including science in the enterprise merely for the sake of being able to say it has been included. The survey conducted in our schools indicated that many teachers experience difficulty in integrating naturally as much science with the enterprise as they think children should have. It is one purpose of this bulletin to give guidance to teachers--as indicated in the grade outlines--with respect to where the science can be best integrated or where some other approach may be necessary.

The parallel activity approach refers to teaching science as a subject in its own right. Either it appears as such on the timetable or it is labelled a parallel activity. Regardless of the name by which is has been known it appears to have served a very useful purpose. It was here that teachers taught the parts of the science program which they found it impossible to integrate with the enterprise. If all science teaching were done by this method at the elementary level, many opportunities for children to learn how science is an integral part of all living would be lost. The sections of the science program covered by this approach may be taught informally, or as an enterprise or as a teaching unit.

The incidental approach is a common method in many classrooms. At Division I level it is sometimes called "show and tell" and is used by teachers in varying degrees. If a child brings into the classroom any object, such as a rock, a feather or a flower, or if he can relate an interesting experience, then instruction is given about the object or experience. The incidental approach does much more than discuss and build science concepts regarding things brought into the classroom. If this approach is to be really useful the teacher must be aware that the world of physical science is either visible from or a part of the classroom. We need to go little further to give the students an understanding of the nature of the world. Inertia, friction, gravity are forces with which the students deal each day. The light from the sun, reflection of light can be observed in every classroom. Air, the nature of air, its expansion, its contraction can be studied as we observe the ventilation system of a given classroom. The list of science concepts which can be related to the experiences and observation of students in a classroom can be extended indefinitely.

An understanding of the nature of our world for an elementary school student does not depend upon a laboratory filled with shining equipment. It does depend upon a teacher who will take the time to explore and relate the experiences and observations of the students to the world of science. If the teacher encourages the pupils to investigate their environment, to relate experiences and bring in specimens, a very meaningful type of science program can grow easily and naturally. This approach can be used extensively in exploring the local environment. The sharing of such experiences is highly motivating and should be the basis of many worthwhile science learnings.

Teachers should strive to integrate science with the social studies in the enterprise. However, a blending of the three approaches will give a well rounded program.

THE TEACHER AND THE ELEMENTARY SCIENCE PROGRAM

The Importance of the Teacher

The teacher, more than any other factor, determines the quality and effectiveness of instruction. This is equally as true in the teaching of science as in the teaching of any other school subject. It is unfortunate that some elementary teachers are so hesitant to use science as a vital and stimulating part of the elementary school program.

Research indicates that many of the questions children ask are of a scientific nature. Many of the subject fields studied in elementary school-- social studies, health and arithmetic--have scientific aspects. In school, at home or on vacation children cannot escape the influence of science or avoid seeing its manifestations. Ours is a scientific age and science should enjoy an important place in the elementary school curriculum.

In the recent survey in Alberta and in other surveys conducted in United States, teachers list many reasons for a feeling of inadequacy in teaching science: lack of training, unsatisfactory courses of study, lack of encouragement from administrators, fear of reaction of parents, lack of time, equipment or facilities, and many others. It is hoped that this bulletin will help teachers realize that elementary science can be a stimulating and rewarding experience for teacher and pupils and that many of the so-called obstacles really do not exist.

What Are the Objectives of Science In Elementary School?

Let us start by asking ourselves this question, "What is Science?" At the risk of over-simplification, let us say science is a method of discovering new facts and seeing new relationships, solving problems, satisfying curiosity, exploring, finding answers, as the child comes in contact with an ever broadening environment. As the child proceeds through elementary school, science should help him

(1) know some generalizations or science principles (big meanings) that he can use in solving problems in his environment,
(2) grow in ability to solve problems effectively,
(3) develop a scientific attitude and think critically,
(4) develop an interest in and appreciation for the world in which he lives,
(5) build an ever-increasing store of useful scientific knowledge.

These objectives are simple and attainable in any classroom. It does not require a human encyclopedia of scientific knowledge to direct the experiences of children to help them grow toward realization of these objectives.

The Teacher's Job

There are many things in the teacher's favor as she approaches science teaching, regardless of her own background in the subject. Remember, almost all girls and boys like science. When they first come to school they have probably had more first hand experience with the world of science than with any other subject field in the curriculum. The local environment is always present with a wealth of natural phenomena, waiting to be explored. Every community has specially qualified people, district agriculturists, engineers, bird watchers, etc., who are usually willing to help. There is an abundance of excellent literature on elementary science and how to teach it. Most of the equipment needed is readily obtainable, experiments are simple and require little manipulation. Audio-visual aids--particularly filmstrips--for this subject field are very numerous. Teachers do not need to know all the answers. Pupils will not think any less of the teacher if she says "I do not know" IF they and the teacher proceed to see if an answer can be found.

Teachers should keep science in the elementary school simple. Children should be given as much opportunity as possible to handle, to manipulate, to try things, to read, to find answers, to explore. Children will learn much from growing things, caring for pets, watching experiments and doing things that have real meaning to them. The readiness of children for the science program at any grade level is something of which teachers need to be aware. The developmental characteristics of each age group have important implications for the teacher of science. The urge for constant physical activity in Grade I suggests caring for plants, caring for fish in an aquarium, and going on short, well-planned field trips. Uneven muscular development at this same age suggests manipulation of large things, such as building inclined planes out of large blocks. Space does not permit a detailed treatment of this topic here but similar information is available for all grade levels. Teachers are reminded of the need for knowing the background and range of previous experiences of the pupils in order to suit the program to their needs and abilities.

The teacher's most important contribution to the children's growth through science will be her own scientific attitude. If she encourages participation and experimentation, varies the activities and approach to the subject she is developing the valuable concept that "we do science" not "learn about science." If her teaching is frequently punctuated with such phrases as "Let us find out", "I wonder what will happen", "Do we know that?", "How do we know?", "Why did that happen?" and steps are taken to find out, the teacher is giving her pupils some valuable leadership in elementary science. On the other hand, if the teacher supplies all the answers and gives the impression that these are the last word and final authority, without helping the children to find their own answers, the major objectives of elementary science cannot be realized.

If a teacher approaches the science program hesitantly, the cure can be relatively easy. If a start is made, the teacher and the children will learn a great deal together. In addition, the teacher should remember that other staff members, the principal, the superintendent are always willing to give assistance. There are many fine teachers' references in elementary science which will give valuable suggestions for the program. Teachers are encouraged to adopt a scientific attitude and to do some experimenting in the teaching of science.

Teachers will realize their science program is bringing results when their pupils show increasing ability to:

(1) plan experiments carefully
(2) not accept superstition as proof
(3) realize there is a cause for every effect
(4) withhold judgment until sufficient evidence has been procured
(5) change their minds in the face of new evidence
(6) go to reliable sources for information and evidence
(7) respect the point of view of others
(8) think critically
(9) be accurate in observations
(10) interpret science phenomena in their environment

Science in Your Classroom

Do you ....

1. Read the literature in elementary science? There is no substitute for knowing what the best teachers of science are thinking and doing.

2. Make use of the suggestions in the manuals and teachers' editions which accompany the science readers?

3. Foster the idea of let's find out by directing the observations of the students and planning experiments with the students?

4. Evaluate your efforts regularly with tests, by keeping anecdotal records of committee work, of experiments and of field trips?

5. Participate in workshops and study groups in science?

6. Use instructional material available in your library and in your community?

7. Use your knowledge of children's growth patterns in planning the program?

8. Use the facts and information that your students have gathered to build science generalizations?

9. Use the resources of the community?

10. Take the pupils on well-planned field trips?

THE PRINCIPAL AND THE SCIENCE PROGRAM

The principal occupies a key position in improving the science instruction in his school. He has the opportunity of supplying the necessary leadership to help make science a vital and stimulating part of the elementary school program. The present science course--with its increased emphasis on the local environment--suggests a greater opportunity and need for the principal and his staff to plan co-operatively how this source can be used to make a maximum contribution to the science experiences of the children.

Using community resources involves bringing the community into the classroom as well as taking the pupils from the classroom into the community. The first step in doing this is to make a survey of the local resources. On the basis of this information the principal and his staff should plan how these resources can make a maximum contribution to the science program. This will assure each child who attends the school a definite program of community experience in science without needless repetition of some experiences and omission of others.

Resource units should be developed containing necessary information for the teacher concerning the following: local flora and fauna, general topography, rock formations, dams, sloughs, rivers, soil types, conservation practices, and any other useful data. The completed resource units should form a part of the school library.

The principal should accept responsibility for making teachers aware of what materials and equipment are available or easily procurable. Staff confidence increases when help is readily available. A science section in the library containing pictorial material, teachers' references and professional magazines will improve the science program.

Teachers will welcome the opportunity to discuss the objectives, content and methodology of the science course. Some staff meetings should be devoted to a study of the elementary science course. Teachers should be encouraged to form study groups to evaluate the science program. Field trips should be organized to give teachers an opportunity to study the local environment. Such trips will increase their confidence and improve their techniques in conducting field trips with the pupils. Special people in the community can assist teachers by leading discussions and by giving lectures. As the teacher's background in science, and her confidence in her ability to teach it, improve, so will her interpretation and enjoyment of the program.

Evaluation is essential. It must concern itself with the objectives of the course. Since the science course emphasizes experiences and resulting behavior patterns, evaluation must be set up accordingly. Testing for factual knowledge will be necessary but will not give all the information required. The more basic aspects of behavior , such as understandings, attitudes and the actual activities in which one engages, must also be assessed.

Such forms of testing and evaluation as the following, with suitable local variations and extensions, may be used to good advantage:

(1) science vocabulary and meanings
(2) recognition of plants and animals in the local environment and how they live
(3) application of science principles to problems in the school, home and community
(4) participation in bird clubs, airplane clubs, hobbies, etc.
(5) checking for growth in scientific observation
(6) checking for increased use of the scientific method
(7) noting changes in attitude toward opinions, evidence, superstition, etc.
(8) recognizing and understanding of mechanical principles and machines
(9) noting evidence of widening interests and increasing curiosity
(10) noting the development of ability to arrive at generalizations.

As the question and answer type of test will not measure these phases of growth, it is necessary that check lists, anecdotal records and careful observation by the teacher become a part of science evaluation.

IMPROVING THE SCIENCE PROGRAM

EXPERIMENTING

Keep Experiments Simple

Experimenting holds a great interest for children of all ages. The thrill children get from "trying out", "finding what happens" is an excellent interest on which teachers should capitalize. In elementary school, experiments should be simple. If elementary teachers use high school methods of approach and expect written reports containing five or six detailed steps in experiments carried out by elementary pupils, disappointment is almost certain to follow. In the early stages of experimenting in the elementary school where the experience is a new one to the pupils it is sufficient to say "Let us see what happens". Later on the teacher can expand procedure to two headings, the purpose of the experiment and directions as to how the experiment will be done. If the approach to experimenting is gradually made more detailed, by the time children leave elementary school, a good working knowledge of the process should be a part of their science understanding.

Make Pupils Think

Science experiments should be performed in such a way as to cause pupils to think. If the teacher has already told the pupils the answer it is not necessary to perform the experiment. Experiments require careful planning with the children sharing as much of the planning as possible. Pupils should not be allowed to make sweeping generalizations as the result of the findings of one experiment. The purpose of the experiment should be to help children to understand an idea or answer a question. However, it must not stop there. The experiment should have been chosen so that the children may apply the findings to similar situations in the world about them. This application to real-life situations determines if the experiment has any meaning to the children.

Let the Children Do Experiments

The great majority of experiments conducted in the elementary school should be sufficiently simple and safe that the children can perform them. If classes are large, experiments can be performed in small groups. It is well to remember that watching an experiment done is quite a different type of experience from actually doing it. Children should be encouraged to plan their own experiments. This will give opportunity for careful planning and organizing, as well as scientific thinking. Long range experiments have a place in the elementary school. Caring for pets, growing plants, observing changes over long periods of time give children experience with different but very important types of experiment. Children should not be permitted to do experiments aimlessly and without purpose. They should always know what they are doing and why they are doing it. They must have a purpose.

Written Records

It is neither necessary nor desirable to have children make complete formal records of experiments they perform. In Division I too great an emphasis on written records will detract from the natural interest children have in experimenting. There should be a steady growth in the completeness of written records from a very simple two-or-three-sentence report to a reasonably complete type of statement by the end of Grade 6. If experiments take longer periods of time to perform, children should learn the desirability of regular observations and brief notes to record them. Drawings can be used to good advantage in recording experiments. Keep them simple.

Experimenting is only one way of learning in science. It is important but its potentialities will be realized only if it is used in terms of supplying answers to questions and problems of children as they see them in their environment. Experimenting can make work in science more interesting, more meaningful, and can provide plenty of opportunity for thinking, reasoning, planning and observing.

REFERENCE BOOKS AND SCIENCE READERS

Reading to find the answers is a necessary part of any good elementary science program. Children cannot learn everything by first-hand experiences. Children can learn much from reading science readers, reference books, magazines, etc. The one prime danger is that science may degenerate into a text-book course. With care this danger can be avoided if the teacher will observe the following precautions:

(a) Know what information can be obtained from the books
(b) Direct the reading of the class to locate answers to questions
(c) Make sure that no one book is used as a text

Reading may either follow an experiment to check results or may suggest an experiment to see something first-hand. Reading should preferably be done from a number of sources rather than from one. Science is an excellent place to have pupils experience reading for information. Supplementary books in science may be used by some individuals as reading for pleasure. Reading is a necessary tool in the elementary science program.

OBSERVING

Teaching children to become careful observers is one important objective of the science program. As children are required to observe more carefully and to report and to interpret more scientifically, they are developing necessary abilities for further study and for participation in adult society. The importance of observation has been emphasized in the section which discusses experimenting. The need for careful observation becomes apparent as we study the local environment. This program emphasizes the importance of the local environment in developing science concepts. As pupils are taught to be better observers, to learn to use their senses of seeing, hearing, smelling, touching and feeling, the local environment will become a stimulating and interesting source of information. Encouragement to practice observing is given by helping boys and girls to identify what they find, by telling them some of the interesting things they may see if they look carefully and by arranging field trips where the teacher helps them to locate interesting features of their environment. As children are given help and direction, they develop the power of observation to a much greater degree of efficiency. Each season brings with it a wealth of natural phenomena which children must be taught to see. As children improve in the ability to observe the effectiveness of experiments, field trips and visual aids will be increased. Careful, accurate observing must be one of the results of a good science program.

FIELD TRIPS

In every community there are places to see and explore that will add meaning to the science program. Field trips to these places should help pupils to gain information, solve problems and develop appreciations. These desirable benefits do not necessarily follow because a group of children and a teacher take a field trip. A poorly planned trip can and often does result in disappointment for the teacher, a "holiday" for the children and bad public relations for the school.

A field trip must be carefully planned to be successful. There must be, first and foremost, a reason for taking the trip. This reason should be known to all. There should be group planning for safety, transportation, time schedule, note taking, as well as desirable conduct and courtesy. Either the teacher or the teacher and a committee of pupils should make a preliminary trip. This procedure will give the teacher confidence and provide background to give more specific guidance to the pupils. Field trips should be informative as well as interesting, and an integral part of the school program.

During the trip pupils must be kept under the direct and careful control of the teacher. It is often helpful to have groups of children under a leader looking for specific points of interest. As soon as the pupils have accomplished the purpose of the trip they should return to the classroom. Difficulties and trouble often develop if children are allowed to explore aimlessly.

The follow-up of the field trip is very important. Information should be recorded and the application of it to the specific problems made clear. This should be done as soon as possible following the field trip, preferably the same day.

Good field trips can be planned in either rural or urban areas. Many teachers in urban schools feel that field trips are not practical because they think it involves taking children out into the country. This is not necessarily so. It is well to remember that vacant lots, back yards, parks, zoos, market gardens, greenhouses, museums, lakes and ponds present many valuable learning situations. For the physical sciences, rivers, river banks, hills, weather bureaus, airports, broadcasting stations, factories and industrial plants offer many excellent opportunities.

Field trips can be a vital and effective part of the science program. However, if not carefully planned and well carried out, they can be a most unsatisfactory experience. Very careful planning is a 'must'.

THE SCIENCE CORNER

A well organized science corner is necessary to teach elementary science. It can become the motivating force necessary to originate and sustain activities in reading, language, arithmetic and social studies as well as the science-health areas. It becomes an interest center where pupils may examine collected items, find related reference material, conduct simple experiments or observe the wonders of an aquarium or terrarium. The science corner not only satisfies individual interests, it also contributes to good group living. The establishment of such an interest center calls for co-operation in the planning and execution of any project. Responsibility certainly must be an outcome of its maintenance. Things of nature appeal to all children.

The science corner may vary greatly from room to room and from school to school. A lowly orange crate or an empty desk will serve as a display and storage space if necessary. Location away from assembly areas and near a light source is advisable. A nearby wall is necessary as a tack board base. When the location of the science area becomes a class problem the co-operative solution should result in a sense of ownership. As it grows in size the busy teacher will find the class capable of providing suggestions for expansion.

A printed card should designate the agreed location. Any flat surface will serve to support a beginning collection of rocks, plants or shells. The end of a work table may be reserved for the display of collections or science projects. Shelves or drawers are useful for the storage of equipment used in science demonstrations or experiments. A tack board is a necessity for the display of printed matter related to the project in hand. An aquarium or terrarium provides a center of interest which may lead to the development of many nature study units. A simple filing system is essential if the various pieces of information are to be readily available. The science reference library should be located nearby and a number of chairs supplied for pupils to sit down while they read, and to observe an experiment.

The science corner is more than a visual aid. It is a library, a laboratory, a museum and a workshop. It is dynamic, changing with the seasons and the interests of the pupils. It results in enthusiastic pupil participation in practical experience in problem-solving, and is a source of motivation.

AUDIO-VISUAL AIDS

There are many audio-visual aids available to assist in the teaching of science. They include filmstrips, moving pictures, still pictures, diagrams and models. They can be used to assist but never replace the teacher. They will contribute as the teacher explains them, as the pupils examine and discuss them and as they encourage further study. Audio-visual material should be chosen carefully as should any instructional aid. They need to be evaluated regularly in terms of what they are expected to accomplish.

The selection of audio-visual materials should be made with due regard for such factors as purpose, attractiveness, accuracy, use and cost. Materials should be applicable to the science program. Once they have been acquired they must be taught, not merely displayed. It is preferable to use them in the regular classroom situation as an integral part of teaching procedures. If used to excess, much of their effectiveness is lost.

The following steps in using audio-visual aids should improve their effectiveness:

(a) Select the material on the basis of a real need.
(b) The teacher should become thoroughly familiar with the material. It should always be previewed at least once.
(c) Make certain the children know what questions the material is expected to answer. It is essential that the children are prepared for what they should expect.
(d) Use the material as it seems to best meet the needs of your class.
(e) Have a definite follow-up. Most of the possible value is lost if this is not done.
(f) Re-teach the material if pupils seem to have a need for it.
(g) Evaluate the effectiveness of the material.

SCIENCE MATERIAL AND EQUIPMENT

The problem of obtaining apparatus and other material for use in demonstrations and experiments in science in the elementary school is not nearly so difficult to solve as many teachers believe. It is not necessary to spend a large amount of money for expensive apparatus. Most science experiments in the elementary grades are simple and the materials should also be kept simple. Home-made equipment often serves the purpose as well as, or better than, more elaborate purchased equipment.

The materials to be used in the science program surround us, always in sufficient amount, and usually in great abundance. The wealth of natural objects and phenomena, animate and inanimate, the multitude of articles manufactured and used by man, and the laws and principles that govern the operation and use of materials, toys, tools, machinery and equipment of every sort all have a contribution to make to the science program.

The following list of materials is considered to be about the minimum number of items necessary to teach elementary school science. The list is for the purpose of assisting teachers in assembling the essential equipment for establishing a science program. It is divided into two parts: (1) Obtainable from Scientific Supply Houses (2) Obtainable from Local Sources.

1. Obtainable from Scientific Supply Houses

Recommended Quantities	Description
3	Beaker, Pyrex, 250 ml.
3	Beaker, Pyrex, 400 ml.
1	Burner, Alcohol, 4 oz.
2	Dry Battery
2	Flask, Erlenmeyer, 500 ml.
1	Funnel, Glass, 75 mm.
12 ft.	Glass Tubing 5 mm.
1	File, Triangular, 5 in.
4	Rubber stoppers, Solid #2
2	Rubber stoppers, 1 hole #2
4	Rubber stoppers, Solid #5
2	Rubber stoppers, 1 hole #5
2	Rubber stoppers, 1 hole #7
2	Rubber stoppers, Solid #7
4 ft..	Rubber Tubing, 3/16 in.
1	Support, Test Tube
12	Test Tubes, Pyrex 150 x 18 m.m.
2	Thermometers, 10-220F
1	Clamp Test Tube Holder
1	Spring Clamp
1	Burette Clamp, adjustable
1 lb.	Acid, Hydrochloric Concentrated
¼ lb.	Copper Metal, Foil
1	Zinc Battery Element
¼ lb.	Bell Wire, D.C.C.
1 lb.	Manganese Dioxide
1 lb.	Potassium Chlorate
1 lb.	Marble Chips
1	Horseshoe Magnet
2	Bar Magnet
1	Prism, Glass
2	Lens, Double Convex
¼ lb.	Iron Filings
1	Ring Stand with 2 rings

The following are also obtainable from the above source:

1. Litmus paper
2. Spring Balance
3. Electric Bell or Buzzer

2. Obtainable From Local Sources

(a) Living Things

1. Fish, snails, water plants, etc. for aquarium
2. Turtle, frog, salamander for terrarium
3. Seeds (bean, corn, etc.)
4. Growing Plants (geranium, begonia, ivy, bulbs, cactus, mushrooms, etc.)
5. Algae, larvae of different kinds

(b) Glassware

1. Fruit jars
2. Milk bottles (and caps)
3. Glass tumblers
4. Lamp chimneys
5. Reading glass
6. Small mirrors
7. Window glass (4" or 6" squares)
8. Pyrex nursing bottles
9. Compass

(c) Construction Materials

1. Jars containing assorted nails, tacks, paper clips, screws, elastic bands, etc.
2. Hammer, pliers, file, screw driver, knife
3. Glue, paste, shellac
4. Sandpaper
5. String and cord
6. Small tins of paint and varnish.
7. Adhesive tape

(d) Chemicals

1. Soda
2. Starch
3. Sugar
4. Lime (Slaked)
5. Red Ink
6. Vinegar
7. Table salt
8. Paraffin
9. Ammonia
10. Iodine
11. Dry Ice

(e) Collections

1. Seeds
2. Leaves
3. Shells
4. Bird nests
5. Local rocks, minerals, etc.
6. Insects
7. Science pictures of various kinds

(f) Miscellaneous

1. Box of garden soil (about 2 qts.)
2. Box of sand (about 2 qts.)
3. Box of sawdust
4. Flashlight bulbs and sockets
5. Balloons
6. Medicine dropper
7. Magnets
8. Blotters
9. Animal cage (or material to construct it)
10. Paper cups
11. Bowls and flower pots
12. Pot-holder
13. Spoons of different metals
14. Old electric switches or push buttons
15. Old copper wire
16. Soda straws
17. Slat cartons
18. Toys (boats, blocks, trains, wagons, steam engine, airplanes, etc.)
19. Old bicycle pump
20. Old clothesline pulleys
21. Sponges
22. Tin can and stopper (syrup tin)
23. Mailing tubes
24. Old storage battery, and worn out dry cell
25. Cellophane (clear and colored)
26. Candles (large and small)
27. Old rubber hose (from bath spray)
28. Old light bulbs and fuses

DIVISION 1

GRADE 1 SCIENCE UNIT

STUDYING WEATHER IN THE FIRST GRADE

By Grace P. Gist
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The National Elementary Principal
Vol. XXX111. Number 1

A rainy day presented a fine opportunity to introduce a unit on weather to our first-grade class. A discussion of rain drew attention to the ways in which weather changes. We talked about sunshine, rain, snow, clouds, and winds. The classroom teacher suggested that it might be interesting to keep a record of the weather. The children became enthusiastic and decided to start a weather calendar for the month of January.

PREPARATION

In preparation for our study, the children were asked to search for pictures illustrating various kinds of weather. These, along with others contributed by the teacher, were displayed, and considerable discussion followed. The class talked about sunny-day activities, rainy-day activities, and things that could be done on a windy day. We also discussed the best ways to dress for each kind of weather.

ACTIVITIES

The following day we decided to write about our discussion of weather, and the children composed the following statements: "There are many kinds of weather. We have rain, sunshine, wind and snow. Sometimes it is hot and sometimes it is cold."

The teacher made a large weather calendar with a space for each day in the month of January. The children were given hectographed copies of the calendar on which they kept a daily record of the weather for the entire month. Each morning the class decided which symbol would represent the weather for that day, and each child would check his calendar accordingly. The teacher would make the recordings on the class calendar.

Many other activities contributed to a better understanding of our unit. One was the drawing of pictures showing the weather each day. One child was always permitted to do this with finger paints. While most class members kept themselves busy drawing at their seats, a few children worked on a mural at the board using colored chalk. Such work called for close supervision and much help from the teacher; however, the children were so interested in what they were doing that their efforts resulted in unusually fine art work for first-graders.

Each morning our experience story developed as a result of our observation of weather for that day. After free discussion of the weather, the children would make up stories like:

It is raining today. See the dark clouds in the sky. They are rain clouds. Rain comes from the clouds.

The rain is over. The sun is now shining. See the rainbow in the sky. The rainbow comes after the rain.

The writing of our experience stories constituted the major part of the handwriting experience in the unit. The stories of many of the children were displayed along with the mural and other drawings of weather. Among other stories composed were:

See the sun. The sun is shining. The sun is in the sky.

Today is a cloudy day. There are many white clouds in the sky, but they are not rain clouds.

The wind blows. It blows the clouds in the sky. It blows kites and clothes too.

The study of the rainbow came as a result of our discussion of rain. Because most of the children had seen a rainbow, the teacher felt that the rainbow should be considered. We secured a glass prism and each child was given an opportunity to observe the colors in their proper sequence.

The study of snow was presented vicariously through books and pictures which we had on hand in our classroom library and through the experiences of those few children who had seen snow. However, the children followed up their study with story writing and drawings in much the same manner as when studying other elements of weather. Other activities to further our interest in weather included observations, excursions, demonstrations, and experiments.

ACTIVITY CARDS

The teacher made activity cards, color-coded according to the following subjects:

Weather - Draw a picture to show what kind of weather it is today.

Clouds - Breathe on a window pane. Note the pane "clouds" with moisture.

Rainbows - Let sun shine through a prism. This is the way the sun shines through raindrops and forms a rainbow.

Cold and Hot - 1. Watch a thermometer to see the red line move down when weather is cold and up when it is hot.
2. Fill a jar full of water. Cap it tightly and place it on the window ledge. When the water freezes, what happens to the jar?

Wind - Go for a walk and look for signs: the wind blowing leaves, clothes blowing on a line, the wind in our faces as we walk. Make paper pinwheels and let the wind turn them.

WATER THAT WOULD NOT FREEZE

All the above activities were carried out after a careful explanation of the purpose for which the activity was presented. In learning about hot and cold weather, the children learned to read the thermometer. One very cold day our thermometer outside read 20 degrees. It was on this day, following an explanation of the word "freezing" as 32 degrees on our thermometer, that we decided to carry out the experiment listed under the study of "Cold and Hot." The children wrote the following observations and conclusions:

> Friday, February 2, 1951 - Our thermometer outside read 20 degrees. We filled a jar with water. We capped it tightly and placed it outside the window. The water did not freeze. It had become warmer. The thermometer showed 40 degrees when we brought the jar inside.

EVALUATION

The following simple concepts were developed among these first-grade children:

1. We have many kinds of weather.
2. Sunshine, rain, wind and snow are kinds of weather.
3. By observing clouds and wind we can often predict the weather.
4. Our activities vary with the weather.
5. We choose our clothes according to the weather.
6. There is water in the air.
7. Clouds are moisture in the air.
8. A thermometer shows us how hot or cold it is.
9. The sun gives us light even on cloudy days.
10. Wind is moving air.

SUBJECT INTEGRATION

Our experience stories and experiments presented much material for handwriting lessons. Here we studied letter formation, spacing, and other writing skills. The number of excellent papers placed on display was an indication that writing skills developed during our unit of study. The science vocabulary introduced during the unit included such words as:

blow
rain
rainbow
sky
sun
sunshine

clouds
warm
cloudy
cold
hot
wind

shining
weather
freeze
dark
white
shadows

The repeated use of the words, both in discussion and in writing, made it possible for the children to acquire these words as a part of their reading, speaking, and writing vocabulary.

The use of the numbers 1 through 31 as dates on our calendar gave the children some understanding of the number system. They acquired the knowledge that there are seven days in a week and four weeks in a month; that there were more days of sunshine than rain during the month of January.

As pointed out previously, there were many opportunities for creative art work throughout the entire unit.

DIVISION 1

-

COURSE OUTLINE

LIVING THINGS

(Detailed outline
of Concepts)

GRADE 1

1. ANIMALS

A. Animals live in various environments
   1. Some animals live on land
   2. Some animals live in water
   3. Some animals live on land and can fly
   4. Some animals live both on land and in water

B. Most animals find or build homes
   1. Most birds make nests
   2. Some animals make colony homes
   3. Some animals use shelters they find available
   4. Man must provide shelter for domesticated animals

C. Animals must have food to live and grow
   1. Wild animals find food in the environment
   2. Animals that are domesticated by man must be fed by him

D. Man uses animals for various purposes
   1. Some animals provide pleasant companionship
   2. Some animals provide man and animals with food
   3. Some animals provide man with materials for clothing
   4. Some animals assist man in his work
   5. Some wild animals are confined in order to provide opportunities to observe and study them

E. How do Animals prepare for winter?
   1. Change appearance (color and thickness of coats)
   2. Storing food
      a. by growing fat, b. by stocking a cache
   3. Change habits
      a. hibernate (bears, insects, frogs, etc.) b. stay indoors, c. gather in herds
   4. Migrate
      a. birds, b. animals

II. PLANTS

A. Plants live in various places
   1. Some plants live on land
   2. Some plants live in water

B. People and animals use plants in various ways
   1. Some plants are used for food and clothing
   2. Some plants provide man and animals with shelter
   3. Some plants provide aesthetic pleasure.

LIVING THINGS

GRADE I

Suggestions

1. ANIMALS

Much of this section can be integrated with the enterprise on pets. Parts C, D and E lend themselves most readily; the remaining parts could be well handled as parallel activities.

11. PLANTS

This section can probably be best handled as a separate teaching unit.

Suggested Activities:

A. Field Trips
  1. Field trip to see plants that grow in different places.
  2. Collect pictures of plants that help man and animals.
  3. Collect leaves in the fall when the plants are getting ready for winter.
  4. Grow plants in the classroom - some grow better in bright sunlight, others grow better in shaded spots.

C. How do plants prepare for winter
    1. Change appearance
        a. color, b. foliage
    2. By dying
    3. By going to sleep
    4. They store food in their roots

THE EARTH AND THE UNIVERSE

(Detailed outline of concepts)

GRADE I

1. WEATHER

- A. From day to day
  - 1. Sun, wind, rain, snow and temperature combine in different ways to make our weather
  - 2. Weather changes often
  - 3. We adjust our activities to weather conditions
  - 4. We can predict changes in weather
    - a. dark clouds gather before a storm
    - b. when the clouds begin to break the storm is usually over
    - c. a rainbow usually means the end of a rain storm
    - d. it is often windy before a storm

- B. Through the seasons
  - 1. The seasons are spring, summer, autumn and winter
  - 2. The seasons follow in order
  - 3. Seasons have characteristic weather conditions
  - 4. We adjust clothing and activities to the seasons

II. WHAT WE SEE IN THE SKY

- A. We see the sun in the daytime

- B. We see the moon and stars at night

- C. We see clouds during the day and at night

- D. Sometimes we do not see the sun, moon or stars because of clouds

III. WHAT DO WE SEE ON THE EARTH AROUND US

- A. Rocks are:
  - 1. soft or hard
  - 2. big or small
  - 3. smooth or rough

- B. Land
  - 1. Is flat or hilly
  - 2. grows plants or does not
  - 3. is made of soil and rocks

- C. Water
  - 1. Is seen in lakes, rivers, streams, sloughs and oceans
  - 2. Can make land grow plants
  - 3. Helps to keep us clean
  - 4. Is the place where fish live
  - 5. Is a place for safe play

IV. AIR IS ALL AROUND US

- A. Air is something that is real

THE EARTH AND THE UNIVERSE

Grade I

Suggestions

This section can probably best be taught as separate science unit.

1. Weather - See Science unit suggested in this bulletin.

The other topics might be grouped around a theme such as "What do we see in the sky, on the earth?" These topics could form at least two and maybe more short science teaching units.

- B. How we know there is air
    - 1. We can feel it
    - 2. We can see it move things
    - 3. We can put it in things

V. HOW DO THE SUN, MOON AND STARS HELP US

- A. The Sun
    - 1. Gives us light
    - 2. Gives us heat

- B. The moon and stars
    - 1. Help us to see at night

ENERGY AND MACHINES

(Detailed outline of Concepts)

GRADE I

1. MACHINES

A. We have machines to help us do work
    1. We use machines in our homes
    2. We use machines on our farms
    3. We use machines in our community

B. Machines help us in doing these things easily and quickly
    1. Travelling
    2. Sending messages
    3. Moving things
    4. Building things

C. We should take good care of machines
    1. They should not be left in the rain and sun
    2. They should be fixed if they get broken

II. FIRE

A. We use fire in many ways
    1. To keep us warm
    2. To cook our food
    3. To heat water to help keep us clean
    4. To burn old useless materials

B. We use a number of different things to make a fire
    1. Some stoves burn coal
    2. Some stoves burn gas
    3. Some machines burn gasoline and oil
    4. Some machines use electricity

ENERGY AND MACHINES

GRADE I **Suggestions**

1. MACHINES

This could form a good science teaching unit or could be easily integrated with "We Play House" and "Friends in our Town." If children at this level know the names of common machines and how they help us they have established valuable concepts.

Suggested Activities:

Field Trips

1. To see machines
2. To see them in use if possible

11. FIRE

This could be easily integrated with "Our Family" or any enterprise centered around the home.

LIVING THINGS

(Detailed outline of concepts)

GRADE II

I. ANIMALS

- A. Animals must have food to live and grow
  - 1. Some baby animals eat the same kind of food as the parents
  - 2. Baby mammals get milk from the mother's body
  - 3. The ability to move about is important in food-getting
  - 4. Some baby animals are able to get their own food
- B. Baby animals receive varying degrees of parental care and protection
  - 1. Many baby animals get milk from the mother's body
  - 2. Most baby animals that cannot move about competently are fed by the parents
  - 3. Many baby animals that cannot move about competently get parental protection from enemies
  - 4. Some baby animals get no parental protection

II. PLANTS

- A. Sufficient light and water are necessary for growth
  - 1. Seeds need water to germinate
  - 2. Green plants die if they are deprived of light for too long a time
  - 3. Plants die if they are deprived of water for too long a time
- B. How seeds travel
  - 1. Wind
  - 2. Water
  - 3. Animals
  - 4. Explosion

LIVING THINGS

GRADE II

Suggestions

1. ANIMALS

This unit could be partly integrated under the enterprise unit "Animals that Help Us." To cover all topics listed, the unit would need to include animals that do not help us.

11. PLANTS

This unit could be partly integrated under the enterprise unit "Plants that Help Us", or under "We Visit the Farm." "B" part on How Seeds Travel, would be a natural for a science field trip, and could be kept for a science 'separate'.

THE EARTH AND THE UNIVERSE

(Detailed outline of concepts)

GRADE II

I. WHAT WE CAN LEARN FROM THE SKY

A. Directions
  1. The sun rises in the east and sets in the west
  2. Stars help us find our way

B. The moon
  1. Changes its shape following a regular pattern each month
  2. Has a face

C. Clouds
  1. There are different kinds of clouds
    a. light and fluffy - heavy and dark
    b. high and low
    c. white and dark
  2. Clouds change with the weather
    a. rain clouds are low and dark
    b. fog and mist are low clouds

II. WHAT ARE THE CAUSES OF WEATHER

A. Causes of wet weather
  1. Water goes into the air
  2. Water comes out of the air
  3. Rain falls when it is warm
  4. Snow falls when it is cold
  5. Sleet is a mixture of rain and snow
  6. Fog and mist occur when the air is very wet and so heavy that clouds don't rise

B. The heat from the sun affects weather
  1. In the morning there is less heat from the sun
  2. The afternoon sun is the hottest
  3. The evening sun gives less heat
  4. The sun is in the sky most in the summer and least in the winter
  5. The sun is hottest in the summer and coolest in the winter
  6. We measure heat with a thermometer

C. Wind causes weather
  1. Some winds bring rain or snow
  2. Some winds dry up the rain and snow
  3. Some winds are cold
  4. Some winds are warm
  5. Very strong winds do damage
  6. Winds carry dust and smoke
  7. There are many ways of observing the force and direction of the wind
    a. trees bend with the wind b. airports use wind socks
    c. smoke from chimneys changes with the wind

THE EARTH AND THE UNIVERSE

GRADE II

Suggestions

1. What We Can Learn from the Sky

This unit would be best kept as a separate science unit.

11. What Are the Causes of Weather?

This unit would be best kept as a separate science unit.

ENERGY AND MACHINES

(Detailed outline of concepts)

GRADE II

1. MACHINES

- A. How do machines help man?
  - 1. There are machines that:
    - a. push
    - b. pull
    - c. carry
    - d. lift

- B. What makes machines go?
  - 1. Coal makes some train locomotives go
  - 2. Oil makes some trains, trucks, cars and airplanes go
  - 3. Electricity makes some machines in our home go
  - 4. We push some machines
  - 5. Coal, oil, gasoline and natural gas are called fuels

- C. Where do we get fuels?
  - 1. We get coal from mines in the earth
  - 2. We get oil, gasoline and natural gas from wells in the earth
  - 3. We get electricity from machines called generators which are run by water power or by some kind of fuel

II. FIRE

- A. Fire was discovered by man a long time ago

- B. We must be very careful to control fire

- C. We use fire engines to put out bad fires

ENERGY AND MACHINES

GRADE II

1. MACHINES

A. How Do Machines Help Man?

This unit could be integrated in an enterprise on "A Trip to the City", or in "We Visit the Farm." Local conditions may present an opportunity for the class to actually see the different types of machines at work, e.g. construction of roads or ditches, or a visit to the farm to watch the various machines at work or similarly the city. Such trips can be made into an experience chart story, sketching the types of machines, making individual booklets and completing the unit with a frieze.

B. What Makes Machines Go?

This unit would be best treated as a separate science enterprise and could include C (Where Do We Get Fuels?)

11. FIRE

This unit would fit very well into "Fire Prevention Week" as a special enterprise carried on by the school as a whole.

LIVING THINGS

(Detailed outline of concepts)

GRADE III

1. ANIMALS

A. Animals have structures that enable them to get food in various types of habitats
   1. Some animals can move about and get food on land
   2. Some animals can move about and get food in water
   3. Some animals have structures that enable them to get food on land and in water

B. Animals have primary food-getting structures (enabling them to seize and get food into the body) and secondary food-getting structures (enabling them to locate food and to get to it)

C. Wild-animal life can be conserved by man

II. PLANTS

A. Plants cannot move to obtain food
   1. Roots get food and water from the soil
   2. Leaves get sunshine and air

B. Plants have enemies that can destroy them or retard their growth
   1. Some insects can destroy the leaves and stems of plants
   2. Weeds can retard the growth of other plants

C. Plants are protected by man so that he can derive food and pleasure from them

LIVING THINGS

Suggestions

GRADE III

1. ANIMALS

A. This section could be integrated with Section A of the Enterprise - Our Community. For example, the animal life of Our Community could be used to demonstrate these first 3 headings.

B. Could be included in Section C of the Enterprise. For example in a study of Holland the structures and adaptations of the stork, fish and mole are discussed.

C. Section A of the Enterprise could include the hunting seasons and game restrictions of our Community.

2. PLANTS

A. This also could be integrated in Section A of the Enterprise. For example, the value of irrigation to crops in our Community.

B. & C. This could be covered with Section D. of the Enterprise. For example, in the Story of Cotton a detailed study of the parts of a plant, its enemy, the Boll Weevil, the value of cotton to man, and the different methods of seed dispersal could be included.

THE EARTH AND THE UNIVERSE

(Detailed outline of concepts)

GRADE III

WONDERS IN THE SKY

1. WHAT IS THE SUN?

   A. The sun is many times bigger than the earth

   B. The sun looks small because it is so far away

   C. The sun is the brightest light we have

   D. The sun is made of burning gases like air

   E. Sunlight is composed of all colors

II. WHAT IS THE MOON?

   A. The moon is smaller than the sun and smaller than the earth. The moon belongs to our earth. It is very close to the earth. Other heavenly bodies are very far away. The moon goes around the earth.

   B. It is shaped like a ball

   C. It has no air, no water and no soil on it

   D. It is covered with mountains and valleys

   E. It is very hot by day and very cold at night

   F. There are no plants and animals on the moon

   G. Moon light is not like sunlight
   1. It is not hot
   2. Does not make its own light
   Reflects sunlight like a mirror

III. WHAT ARE STARS?

   A. Stars are other suns - very, very far away

   B. Stars are different colors

   C. Groups of stars are called constellations

   D. Constellations are given names
   1. Big Dipper
   2. Little Dipper (Polaris)

THE EARTH AND THE UNIVERSE

GRADE III

This section of the Science Program could be dealt with in conjunction with Section B of the Enterprise. For example, in an Enterprise on Indians of the Western Plains, a lesson on Columbus Discovering America and proving that the earth is round, could introduce the study of the Earth and the Universe. This could be treated as a parallel activity.

Suggestions

IV. WHAT ARE SHOOTING STARS?

   A. Shooting stars are solid objects travelling through the sky

   B. Scientists call them meteors

   C. Meteors are attracted to the earth

   D. They usually burn up before they reach the earth

V. WHAT IS A PLANET?

   A. Our earth is a planet

   B. There are eight other known planets

   C. Some are bigger than ours, some are smaller than earth

   D. It is not likely that there is life on any of the other planets

ENERGY AND MACHINES

(Detailed outline of concepts)

GRADE III

1. WORK

A. What do we mean in science by work

B. It takes energy to do work

C. Energy can be stored in
   1. Animals' and people's bodies
   2. Fuels
   3. Electric wires

D. Animals help in our work
   1. Animals push things
   2. Animals pull things
   3. Animals carry things
   4. Animals lift things

E. Simple machines help us to do work
   1. The lever helps us to lift or move things by prying
   2. The pulley makes it easier to lift things
   3. The inclined plane makes it easier for us to lift things
   4. The wedge helps us to split things

F. Water helps us to do work
   1. It turns water wheels which do work for us
   2. It turns generators which make electricity to:
      a. run our machines
      b. give us light
      c. give us heat

G. Steam helps us to do work
   1. The steam engine does work for us
   2. Experiment - Can steam push things out of the way?
   3. Steam helps to keep us warm

H. Gasoline helps us to do work
   1. It makes cars, trucks and airplanes go

I. Electricity helps us to do work
   1. It gives us light in a light bulb
   2. It gives us heat in:
      a. electric fire place
      b. water heaters
      c. toasters
   3. It makes many machines go

J. Wind can do work
   1. Wind helps us by:
      a. making windmills go
      b. making wind-chargers go
   2. Wind does damage by:
      a. causing soil to drift

K. Springs do work for us
   1. Clocks run by springs
   2. Toys run by springs

GRADE III

Suggestions

Sections A, B, C, D, F, H, & I of this outline could be integrated in Section A of the Enterprise - Our Community.

Section J could be covered in Section C of the Enterprise - for example, the windmills of Holland.

Sections E, G, K, could be used as experimental lessons in the classroom.

DIVISION II

GRADE SIX SCIENCE UNIT

WHAT ARE THINGS MADE OF?

Elementary-School Science
Chapter 16 - Blough & Huggett

We would caution teachers not to go too far with material on elements, compounds, and chemical changes. On the elementary-school level, the subject should be treated as an introductory experience, and it is important that we do not become technical and involved. The experiments should be kept simple and there should be much observation by pupils in their surroundings to see applications of what is learned. Experience seems to indicate that this material is best taught in the later elementary grades.

COLLECTING ELEMENTS

Once pupils know what the elements are, there are many examples that they can find. Elements are listed in many books.[1] Pupils can find iron, copper, lead, mercury, and many other elements and display them on a table. They may find out more about some of these elements by reading in encyclopedias and elsewhere and report their findings to the class. Before they begin reading, they may make a list of things they are interested in knowing about elements, such as: Where is it found? For what is it used? How was it discovered? Is it scarce? If pupils have questions such as these to guide their reading, they are not so likely to copy from sources and tell uninteresting things that neither they nor their classmates understand. Pupils may make a similar exhibit of compounds and perhaps report on some of the common ones.

CHANGING MATTER FROM ONE FORM TO ANOTHER

To see what is meant by changing matter from one form to another pupils may perform simple experiments to see how this happens. Melt an ice cube by heating it in a dish over a candle or hot plate. (Solid to liquid) Heat the water until it evaporates. (Liquid to gas) Melt some paraffin. Let the paraffin cool. (Solid to liquid - liquid to solid) Note that in these examples no new material is produced. The substance has merely changed its form. Pupils may look about them to find changes from one form to another - especially in the kitchen, where the refrigerator and the stove are.

FINDING PLACES WHERE ELEMENTS ARE USED

Pupils often enjoy discovering the number of ways in which elements are used. Chlorine, iodine, mercury, neon, sulfur, lead, nickel, oxygen, phosphorus, silver, platinum, silicon, and chromium have especially interesting uses. An effective activity is to have pupils volunteer to go ahead on their own in gathering information. Each pupil may keep track of how he went about finding the information - i.e., people he asked, books and other sources he consulted, places he went to observe, etc. If we believe that learning how to locate information is often as important as the information itself, we ought to make the most of activities such as this. Pupils may go to drug stores, garages, paint shops, factories, hardware stores, and similar places. To find information, they may look through books and encyclopedias and talk to dentists, jewelers, merchants, and many other persons.

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[1] Parker, Bertha M., What Things are Made Of. Row, Peterson & Co., Evanston, Ill., 1944, 36 pp.

LOCATING SOURCES OF ELEMENTS

Pupils are often surprised to learn that their own state - perhaps even their own county or community - is famous for products with which it supplies the world. Many of these are common elements, such as copper, iron, lead, mercury, silver, sulfur or nickel. Geography books as well as encyclopedias will be helpful in providing information and, if there are mineral resources in the immediate vicinity, material about them is probably available through the local and state libraries or through the state conservation department.

ILLUSTRATING INFORMATION ABOUT ATOMS AND MOLECULES

The idea of what atoms and molecules are and how they behave is an example of science information that pupils can talk about quite glibly yet understand only vaguely. One way to help them understand more clearly some of the things they learn about atoms and molecules and how they behave is to help them illustrate what they have read. In addition to the textbooks and encyclopedias which pupils are using, several of the books in the bibliography will help to supply ideas.[2] Pupils may make some of the following, either on the blackboard or on a large sheet of white paper: drawings of molecules in a solid, in a liquid, and in a gas; drawing to show what happens to molecules of water when the water is boiling; drawing of a molecule of hydrogen to show the number of atoms in it; drawing to show what happens to the molecules in a piece of iron when it is heated. They will think of other ideas to illustrate.

PRODUCING SOME CHEMICAL CHANGES

Chemical changes function continually in the lives of children, producing many of the things they use every day. There are many simple experiments which even young children can do that show chemical changes. Here are a few: Textbooks and supplementary books give many more. Remember that the important idea for pupils to understand is that as a result of chemical changes new materials are made that may have characteristics entirely different from those of the elements or compounds that went into the process.

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2. Meyer, Jerome S., Picture Book of Molecules and Atoms. Lothrop, Lee & Shepard Co. 1947, 47 pp. This book is very helpful in creating an understanding of molecules and atoms.

Breaking Up a Compound -

Place a teaspoonful of red oxide of mercury (a reddish powder) into a test tube and heat it. As the material is being heated, hold a glowing splint in the open end of the test tube. The glowing splint will burst into bright flame. (Oxygen comes from the red oxide of mercury). Look closely at the sides of the test tube and you will see a silvery metal. It is mercury. The heat is changing the red oxide of mercury from a compound into the two elements from which it is made - oxygen and mercury. Oxygen is an element that is a colorless gas; mercury is an element that is a silvery metal that is a liquid at ordinary temperature. When these two elements are united, a chemical change takes place and the reddish powder is made. When it is heated in the test tube, another chemical change takes place and we again have the two elements. Red oxide of mercury may be obtained from the high school chemistry laboratory or it may be ordered from a scientific-supply house. It often comes in chemistry sets. It is inexpensive, and the experiment described here is very easy to perform.

Producing Rust -

Get two identical large iron nails, and paint one with any kind of house paint that is at hand. Do not paint the other one. Stand both nails in a jar containing a little water and cover the jar, so that the air in it will remain moist. When, after a few days, you examine both nails, you will find that the unpainted nail has rusted but the painted one has not. Oxygen from the air has united with the iron in the unpainted nail to make the iron rust. Scrape off some of the rust and you will see that it no longer looks like the iron. It is a brown crumbly material. The painted nail did not rust because the paint formed a protective layer which kept the oxygen from uniting with the iron.

Observing Chemical Change -

Fill a test tube about one-fourth full of sugar. Heat the sugar and watch what happens. After the white sugar has turned black, let it cool and taste it. It will no longer taste sweet. A chemical change has taken place and a new material has been formed.

Producing Carbon Dioxide -

Pour vinegar on some baking soda and observe what happens. Hold a match over the bubbles. (See p. 365 for more details).

LOOKING FOR CHEMICAL CHANGES

These representative experiments show what happens when a chemical change takes place. Such changes are going on all around pupils and even inside of them. From what pupils have seen and read, they will now be able to answer such questions as "What happens to a bridge when it rusts, and why is it frequently repainted?" "What happens when fire burns?" "What happens to milk if it is left in a warm place for a few days?" "What happens when the soda and acid fire extinguisher is turned upside down?"

Pupils may do some reading and observing to find out: "How is window glass made?" "What happens when silver tarnishes?" "How can sodium (an element that would burn your tongue) and chlorine (a poisonous gas) be made into common salt that is used everday?" "What must happen to oxygen and hydrogen to make them combine to form water?" "What must happen to the food you eat before it becomes a part of you?" "Why are chemical changes important?"

STOPPING CHEMICAL CHANGES

Obviously not all chemical changes are desirable. Some we go to great pains and expense to stop or retard. A little investigating will turn up many examples of this. Each pupil may try to discover for himself and report to the class one example of a way to stop harmful chemical changes. These two suggestions to pupils will help to make such an investigation interesting: "Try to find an example that no one else will find, and tell us where you found the example, and how you happened to find it." Pupils will find such things as paintings, refrigeration, the use of dark or airtight containers, and keeping certain things dry.

USING HELPFUL CHEMICAL CHANGES

Each pupil may be asked to report the two chemical changes that he thinks are most helpful to him. Examples may be oxidation of food in the body, making of starch and sugar in plants, explosion of gasoline to drive an automobile.

An instructive and interesting exhibit may be made of pictures that show important use of chemical changes. The pictures may be found in magazines and newspapers and may be mounted and placed on the bulletin board. Examples are: making pottery and glass, making cement, making paper, baking bread, etc. If pupils are in doubt whether the picture illustrates a chemical change, they may have to identify some of the materials that go into making the product and then decide whether the final product has entirely different characteristics from those of the original materials. In most cases they can decide in this way. As we have noted in Part 1, it is much more effective for pupils to decide the answer to a question than it is for the teacher to tell it to them. With a little careful thinking pupils can themselves decide what general rule may be used and then apply the rule for themselves.

If anyone in the class is interested in developing photographs, he may tell how chemical changes caused by light operate in the making of a photograph. There may be some pupils in the camera club in the junior or senior high school who would like to demonstrate how the various chemical changes function and to explain why films are kept in the dark and why a darkroom is essential in developing pictures.

Chemical changes operate, of course, in the making of blueprints and a group of pupils may be interested in demonstrating how simple blueprints are made. (See pp. 482-483 for directions.)

USING A CHEMISTRY SET

Often children have chemistry sets at home and like to bring them to school. The results range from the production of stinks, stains, and burns to a genuine and permanent interest in chemistry. These sets may be of real value in studying chemical changes. They contain examples of several kinds of elements and compounds, usually have a source of heat, such as an alcohol lamp, and include test tubes and other equipment which will come in handy if they are not available in school. Furthermore, usually the book of directions that accompanies these sets contains useful information about chemical changes and how they are produced.

If such a set is available, it is well to plan with the owner just how it is to be used. Decide on some simple experiment that will show a chemical change which he can comprehend and explain without using terms and materials which no one in the group will understand.

Most of the direction books that accompany these sets contain some safety rules for performing experiments. The owner of the set should follow these rules and perhaps explain them to the class. The class might modify them and compile a set that should be observed at all times in performing experiments.

TESTING MATERIALS

There are several simple experiments pupils can do to help them see that materials may be identified by testing them. Examples of such experiments are:

Testing for Acids -

Use blue litmus paper, which may be obtained from a drugstore or from the high school science department if it is not available in the supply cupboard. Pupils should themselves set up the simple directions for testing. The litmus paper need come in contact only with moisture from the material to be tested. There are some common substances that will turn the blue litmus paper red: lemon, grapefruit, vinegar, sour milk, or any other material that tastes sour. If household ammonia is tested, the pupils will see that it does not turn the blue litmus paper red and will want to know, "If it is not an acid, what is it?" This question will lead to making the next test.

Testing for Bases -

Use red litmus paper. Bases turn it blue. Some common bases that may be tested are baking soda (in solution), limewater, and ammonia. The chief purpose of making these tests is not so much to differentiate between acids and bases as it is to show pupils that there are chemical tests which are helpful in identifying materials.

Testing for Carbon Dioxide -

Place some clear limewater (it may be purchased at the drugstore inexpensively) in a glass jar, dip the end of a straw into the limewater, and blow through it for a few minutes. The limewater will turn milky. Limewater always does this when it comes in contact with carbon dioxide.

Benda stiff wire around a short candle. Light the candle and lower it into a widemouthed bottle. Cover the bottle with a piece of glass. After the candle has gone out, pour a little clear limewater into the bottle and shake it. The limewater turns milky. Again it is not merely the idea of this test for carbon dioxide that is important but also the concept that we have tests that help us to detect the presence of various chemicals.

Testing For Starch -

Cut open a potato and touch its surface with a little dilute iodine. (Iodine dissolved in alcohol may be obtained from the druggist.) The surface of the potato turns bluish purple. Mix a little corn starch in some water. Add a few drops of the iodine solution to the mixture. It too will turn bluish purple, indicating the presence of starch.

DIVISION II

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COURSE OUTLINE

LIVING THINGS

(Detailed Outline of Concepts)

GRADE IV

HOW LIVING THINGS ARE GROUPED

1. ALL THINGS IN THE WORLD ARE PUT INTO GROUPS

   A. The two biggest groups of things are living and non-living

   B. All living things are alike in that:
      1. They can move
      2. They can breathe
      3. They need food
      4. They can grow
      5. They can have young like themselves

   C. All non-living things are alike in that:
      1. They cannot move
      2. They cannot breathe
      3. They do not need food
      4. They cannot grow
      5. They cannot have young

   D. The two biggest groups of living things are Plants and Animals

   E. There are seven groups of animals
      1. Mammals
         a. have fur or hair
         b. babies are fed with milk from mother's body
         c. are warm blooded
         d. take air into their bodies by lungs
      2. Birds
         a. are covered with feathers
         b. have two wings and two legs
         c. have a bill
         d. are warm blooded
         e. breathe with lungs
      3. Reptiles
         a. are covered with scales or shells made from scales
         b. have very short legs or no legs at all
         c. are cold-blooded
         d. breathe with lungs
      4. Fish
         a. are usually covered with scales
         b. have fins
         c. are cold blooded
         d. breathe with gills
      5. Insects
         a. have six legs
         b. have two feelers
         c. have a body divided into three parts
         d. have a covering on the outside of their bodies
         e. breathe through breathing holes on sides of their bodies

GRADE IV

Suggestions

HOW LIVING THINGS ARE GROUPED

1. A, B, C, - These could be learned through guided class discussion as an introduction to one phase of an enterprise in sections C and D.

E. - 1. Discovered in conjunction with the story "Sharp Ears, the Baby Whale", in Young Explorers

2. Birds as food, Section C. Strange birds in new land, Section A. Carrier pigeons, Keep 'Em Flying, Young Explorers.

3. Taught as nature-science lesson.

4. Fish as food, Section C, A, B. Fishing for sport - Jill Catches a Swordfish. Young Explorers.

5. Section A - Pests which harrassed the pioneers.
Section B - Modern control of insect pests.
Section C - Bee as a food provider. How food is protected from insects.
Section D - Doctors, scientists learning about insects as carriers of harmful germs. Ref. The Baby Bears Learn, Young Explorers.

6. Section C. - Black widow in bananas. Shell fish.

F - 1. Section A - How pioneers obtained wheat for sowing.
Section C - Plants as food - root, stem, leaves, tubers, flower, fruit.

2. A, B, C, D, E, F, - Section D - Louis Pasteur, Story of Penicillin.
Section A - Illness of pioneers.
Section B - Diseases common to certain conditions or localities.

   - 6. Others are:
     - a. spiders
     - b. crustaceans

- F. There are two groups of Plants
  - 1. Plants that grow from seeds
    - a. flowering plants
    - b. non-flowering plants
  - 2. Plants that grow from spores.

II. HOW DO SOME PLANTS AND ANIMALS MAKE US SICK?

- A. Many diseases are caused by germs

- B. There are several kinds of tiny plants and animals classed as germs
  - 1. Bacteria cause many diseases, but most bacteria are harmless and others helpful.
  - 2. Some yeasts and molds cause diseases.
  - 3. Certain tiny animals cause diseases.
  - 4. Viruses are usually classed as germs.

- C. When bacteria and other germs get into your body, they cause chemical changes that make you sick.

- D. Bacteria and other germs multiply very fast.

- E. Bacteria and other germs are in or on almost everything.

- F. Germs can be spread easily from place to place and get into your body.
  - 1. Air or moisture from a sick person's nose or mouth, or his dishes, clothing, etc., may spread germs.
  - 2. Impure water, milk, and other foods may spread germs.
  - 3. Flies carry germs on their bodies and spread disease.
  - 4. Insects such as mosquitoes, lice, fleas, etc., may spread germs by biting people.
  - 5. Rats and mice carry lice and fleas on their bodies and spread disease.

THE EARTH AND THE UNIVERSE

(Detailed Outline of Concepts)

GRADE IV

1. WHY DO WE HAVE DAY AND NIGHT?

A. Our earth is a ball

B. Our earth spins

C. Gravity is the force that prevents us from being flung off the earth

D. We get our light from the sun

E. There is a shadow when something blocks the sun's light

F. When one-half of the earth's surface has light, the other half must be in darkness

G. We know the earth spins because day follows night

II. CHANGES IN THE EARTH'S SURFACE

A. Soil is made from rocks and decayed plant and animal matter
   1. Wind and sand wear away rocks
   2. Water wears away rocks
   3. Plants break rocks
   4. Heating and cooling breaks rocks
   5. Animals wear away rocks
   6. Glaciers grind and crush rocks

B. Surface features of the earth are constantly changing
   1. A constant battle between the sea and the land
      a. sea is washing away the land, e.g. English coastline
      b. land is constantly filling in the seas, e.g. deltas
   2. Mountains are continually being built up and broken down
      a. earth is shrinking
      b. slippage and structural faults
      c. volcanic action
      d. forces of erosion are working
   3. The earth has gone through a number of stages
      a. there have been a number of ice ages when glaciers moved in from the poles, gouging out valley and lakes, grinding up rocks and leaving deposits of soil and rock
   4. Undesirable changes in the earth's surface
      a. water washes away valuable soil
      b. wind blows away valuable soil
      c. winds build up sand dunes
   5. What evidence can you find in your own locality regarding any of the above changes?

GRADE IV

Suggestions

1. (This could include zones and seasons, the latter briefly). This could be taught in a number of situations but is well suited to being taught with the measure of time in Arithmetic. This seems to be an easy concept for Grade IV's to learn.

II. A. Hard to integrate as a unit. Could well be used as a separate study.

B.
1. Flooding of our local areas
2. Frank Slide
3. To be taught
4. Local farming practices

ENERGY AND MACHINES

(Detailed Outline of Concepts)

GRADE IV

1. WHAT MAKES MACHINES MOVE
    - (a) Things move because they are pulled or pushed by some force
    - (b) Force is produced by energy
    - (c) Energy
        1. Forms:
            - (a) kinetic - wind, rushing water. The energy of motion
            - (b) potential - food, explosives, etc. The store-up energy
        2. Kinds of Energy and How Machines Use Them
            - (a) Muscles
                1. muscles get energy from food we have eaten
                2. food has energy stored in it
            - (b) Springs
                1. get energy when they are wound up
                2. get energy when they are pushed in or pulled out
            - (c) Gravity
                1. the force that holds things on the earth
                2. pulls things from higher places to lower places on the earth. (Children on a sled)
                3. gives things weight
                4. makes for "up" and "down"
            - (d) Moving Water
                1. moving water has force
                2. the faster it comes, the more force it has
                3. gravity gives water force
                4. the force of gravity makes water run from higher places to lower places
                5. dams are built to raise water to a higher level so that it can fall farther and thus provide greater force
            - (e) Moving Air
                1. moving air has force
                2. the faster air moves, the more force it has
                3. the force of gravity makes air move (i.e. light and heavy air)
                4. people have learned how to make air move to provide force
                    - -vacuum cleaner
                    - -fan
                    - -windmills
                    - -sailboats
            - (f) Steam
                1. steam has force because water takes up more space when it changes to steam
                2. the energy that a steam engine uses is coal, oil or other fuel
                3. every steam engine must have heat and water
                4. uses - steam engines on locomotives and boats
                    - - steam press
                    - - steam drill
            - (g) Energy of explosives
                1. when anything explodes, it suddenly gets very much larger

GRADE IV

Suggestions

1. (a) (b) Section A - Sailboats of pioneers, york boats, arrows of the Indians, etc.

C 1. Section A - as above, also, lack of energy through lack of proper foods.

2. (a) Section A - study of food nutrients
   (b) Use of punch and stapler. Self-closing doors, etc.
   (c) Teach gravity with table of weight in Arithmetic
   (d) Section B, C - use of water power to run machines or to generate electricity to run machines. A Trip to Niagara, Young Explorers. An Adventure in a Lumber Camp, Young Explorers
   (e) Ventilation of school room. Section A - sailboats, blizzards, etc. Section B - farm wind-chargers, Dutch windmills
   (f) Section B - modern steamers, both liners and freighters
   (g) Could be integrated in Section B, modern transportation.

   (h) Taught separately

3. Teach by discussion and blackboard diagrams. Section C - foods for energy. Section B - transference of energy in our modern world.

II. Most of this section will be taught incidentally, if given a little thought.

III. All this section on magnets can be taught through simple experiments carried out by the children. Once they are familiar with the wonders of the magnet the pupils are ready to construct a simple compass. Section A - Voyage of the pioneers. Sections B and C - modern transportation

        2. gasoline and oil have force when they change to a gas in the cylinder
           gasoline changes to gas in the cylinders
           the force of the expanding gas pushes down on the pistons
           the pistons drive the crankshaft and this turns the wheels
        3. the Diesel engine
           furnishes energy to run generators
           the generators run electric motors which turn the wheels
           called a Diesel-electric locomotive

    (h) Electrical Energy
        1. electric current has energy that makes a force which moves things
        2. an electric motor is a machine that uses the energy of electric current
        3. electric current can be made in two ways
           (a) electric current is made to flow by a generator that is run by some other force
           (b) electric current is made to flow by an electric cell

3. How one Form of Energy Can be Changed to Another

    (a) Diesel engine - gasoline engine or hydro-electric power can run a machine to produce electric current to run a motor to turn the wheels
    (b) Electric iron - electric current produces heat energy
    (c) Sun's energy stored in foods becomes muscle energy after we eat the foods

II. HOW CAN WE CONSERVE FUEL AND ENERGY?
    (a) We must conserve our coal, oil, and gas because the supply will not last forever and these fuels can not be replaced
    (b) Fuels may be conserved by using them properly
        1. Insulation 2. Why a stove smokes, etc. 3. Automatic Stokers
        4. Prevent waste heat while cooking
    (c) Fuels may be conserved by using new kinds of fuel or other sources of energy
        1. Make more use of sources of energy such as moving water
        2. Homes made which are heated by the light of the sun

III. WHAT CAN MAGNETS DO?
    (a) What kinds of magnets are there?
        1. Magnets are of different shapes
        2. Most magnets are made of steel, but some are made of a mixture of certain other metals
        3. Lodestone is a magnet found in the earth
    (b) What things will a magnet pick up?
        1. Magnets attract iron and steel
        2. Materials that can be picked up by a magnet are called magnetic materials
        3. Materials which can not be picked up by a magnet are called non-magnetic materials

4. The pull that a magnet has is called the force
5. The force of a magnet can act at a distance from the magnet to pull things to it

(c) What kinds of materials will the force of a magnet pass through?
1. The force of a magnet will pass through many materials
   Examples - (a) paper
   (b) cardboard
   (c) thin wood
   (d) cloth
   (e) zinc
   (f) copper
   (g) tin

(d) What are the poles of a magnet?
1. The force of a magnet is strongest at its ends
2. The ends of the magnet where the force is strongest are called the poles
3. Every magnet has 2 poles
   (a) north pole
   (b) south pole
4. A freely swinging magnet will point north and south
5. The north-seeking pole points towards the north and the south-seeking pole points towards the south

(e) How do magnets act toward one another?
1. Two poles of the same kind are called like poles; poles of different kinds are called unlike poles
2. Like poles of magnets repel each other
3. Unlike poles of magnets attract each other
4. A magnet whose poles are known can be used to find the poles of magnets on which they are not marked

(f) What makes magnets?
1. Particles attracted to magnets themselves become magnets (chain reaction)
2. Stroking other pieces of steel to make magnets
3. Iron & steel (as well as all other things) are made up of very small particles of themselves called molecules
   When a piece of iron or steel becomes a magnet each molecule is made to point the same way, and thus they all work together instead of against one another

(g) Why will magnets point toward north and south poles?
1. The earth acts like a huge magnet
2. The earth has two magnetic poles
3. The north magnetic pole attracts the north pointing pole of a magnet
4. The south magnetic pole attracts the south pointing pole of a magnet

(h) How can you make a compass?
1. Compass is used to tell the direction on the earth
2. A magnetic material can itself be made into a magnet by rubbing it on a magnet

(i) How can you use a compass?
1. The needle of a compass does not point exactly north because the geographic poles and magnetic poles are not the same place.

LIVING THINGS

(Detailed Outline of Concepts)

GRADE V

WHERE DO NEW PLANTS AND ANIMALS COME FROM AND HOW DO THEY GROW ?

I. ANIMALS

- A. Mammals give birth to living young
- B. Birds hatch from eggs
- C. Amphibians hatch from eggs
- D. Reptiles hatch from eggs
- E. Fish hatch from eggs
- F. Insects hatch from eggs
- G. Others
- H. The fewer young produced, the greater parental care exercised

II. PLANTS

- A. Some plants grow from seeds
  1. Where seeds are found
  2. Parts of the flower
  3. How seeds form on flowering plants
  4. Where seeds form on non-flowering plants
  5. Inside a seed
  6. How the young plant inside the seed grows
- B. Some plants grow from roots
- C. Some plants grow from stems and leaves
- D. Some plants grow from grafting
- E. Some plants grow from spores

III. CONSERVATION OF PLANTS AND ANIMALS

- A. We should help conserve wild animals and plants because we need and enjoy them
- B. There are various ways of conserving wild animals and plants
  1. Passing laws against picking certain wild flowers helps protect them
  2. Establishing bird sanctuaries and other wildlife refuges gives animals a chance to grow and produce others like themselves

GRADE V

Suggestions

WHERE DO NEW PLANTS AND ANIMALS COME FROM AND HOW DO THEY GROW?

Sections I, II & IV can probably best be handled as a separate science teaching unit.

Section III may be integrated satisfactorily with Unit B of the enterprise on Alberta

Suggested Activities for Science Teaching Unit on Sections I, II and IV:

A. Field Trips
    1. Where local conditions permit children might be taken to suitable location to find eggs of amphibians, fish, insects.
    2. Field trips to have children find flowering and non-flowering plants

B. Classroom Experiments
    1. Grow plants from seeds, roots, stems, leaves and spores.

IV. WHY DO ALL LIVING THINGS NEED AIR AND WATER ?

A. Animals need the oxygen in the air to stay alive

B. Animals take oxygen from the air when they breathe

C. People need oxygen from the air
   1. Oxygen helps keep the body warm
   2. Oxygen helps the body move

D. Plants need Air

E. Air gets into plants through tiny openings in their leaves

F. Plants use oxygen from the air in order to use food

G. Plants use carbon dioxide from the air to make food

H. Water is needed to dissolve food materials before plants can use them
   1. Dissolved food materials in the soil are carried into the plant when the water soaks into the roots
   2. Sap, made mostly of water, carries food materials and food to all parts of the plant
   3. The food material in a seed must be dissolved before the young plant can use it for growing

I. Water is needed to make juices that dissolve and otherwise change food so that the bodies of people and animals can use it

J. Water provides the liquid part of the blood, which carries food and oxygen throughout the body

THE EARTH AND THE UNIVERSE

(Detailed Outline of Concepts)

GRADE V

I. WEATHER AND HOW WE FORECAST IT

- A. Causes of precipitation
  - 1. rain
    - a. Sun causes moisture to evaporate from the earth's surface
    - b. moisture is held in the air in the form of vapor
    - c. cold air holds less moisture than warm air
    - d. when there is too much moisture in the air for the temperature, precipitation occurs
    - e. in warm weather this precipitation is in the form of rain

  - 2. Hail
    - a.. hail is the result of the following things happening:
      - 1. rain drops fall
      - 2. they are caught by up-drafts of air
      - 3. if sufficient height is reached, they freeze
      - 4. becoming heavy, they fall again
      - 5. Nos. 3 and 4 may be repeated numerous times , each time altering the size of the hailstone

  - 3. Snow
    - a. refer to "rain" above and the same concepts apply except the air is at freezing temperature
    - b. each snowflake has its own shape
  - 4. Sleet
    - a. this is a mixture of rain and snow

- B. Causes of Wind
  - 1. Wind is air in motion
  - 2. Heat causes air to rise
  - 3. Colder air rushes in to take its place

- C. Weather Forecasting
  - 1. Weathermen keep records pertaining to
    - a. wind direction and velocity
    - b. moisture content of the air
    - c. temperature
    - d. pressure of air
  - 2. This has enabled them to tell what conditions precede various types of weather
    - a. high pressure means continuation of current weather
    - b. low pressure precedes a wind which may bring storms of various kinds
    - c. high moisture content may bring rain or snow

GRADE V

Suggestions

This unit can be well integrated with Part C of the enterprise "How Global Patterns Affect Us."

Suggested Activities

A. Field Trips
   Visit to local weather station or airport

B. Classroom experiments
   1. To observe weather changes over a period of weeks and to keep a record of these changes.
   2. To observe how the temperature changes during the day
   3. To show that the sun's rays heat some materials more than others
   4. To show how air moves in a room.
   5. To observe condensation of water vapor from the air

ENERGY AND MACHINES

(Detailed Outline of Concepts)

GRADE V

I. HOW MACHINES CAN FLY

A. Before Machines could fly
   1. Men tried to imitate birds but their muscles were not strong enough
      a. Creeks b. Da Vinci c. Besnier
   2.. Plants float by:
      a. large but light wind catchers (milkweed, dandelion, cottonwood)
      b. by whirling like a propeller (maple, ash)
      c. by skimming like a plate (elm)
   3. Insects that fly, fly by flapping their wings very rapidly.
   4. Flying squirrels jump and float on the sail made by their skin
   5. A bat has skin-wings
   6. Flying fish leap and sail
   7. All birds can't fly
   8. Most birds are built for flight
      a. their wings are larger than their bodies
      b. they have very strong muscles
      c. their bones are strong and light (hollow and spongy)
      d. they eat a large amount of food for energy
      e. their feathers are built to push the air and yet are very light
      f. gulls glide and soar on rising air currents

B. Gliders
   1. Use the wind and air currents as gulls do
   2. They get off the ground by:
      a. ground tow
      b. air tow
      c. catapult
      d. reeling in on power take-off of truck
   3. Their travel depends on the air currents
      a. max. height = 3 mls.
      b. max. distance = 500 mls.
      c. max. time = 50 hrs.

C. Airplanes with Motors
   1. Propellers pull plane through air
   2. The curved profile of the wing keeps it in the air by creating unequal pressures
   3. Air tunnels are used to experiment with wings
   4. Most airplanes can't slow down or they will drop
   5. Helicopters move their wings and therefore can stay in the air

D. First Airplanes
   (examine story of early flights e.g. Wright Bros. etc.)

E. Jet Airplanes
   1. Jet airplanes fly in the same way that balloons fly when we cut the string that holds the Nozzle

ENERGY AND MACHINES

GRADE V

Suggestions

1. HOW MACHINES CAN FLY

This unit might be handled by integrating it with Section D of the enterprise - "How Science Has Affected Our Culture."

Suggested Activities:

A. Field Trips

  1. Trip to local airport if possible

B. Classroom Experiments

  1. To show that air pushes upward as well as downward

  2. To show how a backward rush of air can drive something forward

   2. Scientists have to develop new shapes to meet the needs of tremendous speeds
- F. Safety in Air Travel
   1. Pilots are given a very thorough training
   2. Aircraft are closely inspected
   3. Flights are regulated according to weather reports
   4. Planes can fly "Blind" on the beam
   5. Radio keeps flying safe
   6. So does radar

II. HOW MACHINES HELP US TO DO WORK

- A. What is work? Work is force applied through distance
- B. What is a machine?
   1. A device to make work easier
   2. A force must be used to make a machine work
   3. Simple machines have only a few parts
   4. Complex machines are made up of simple machines put together differently

- C. Levers
   1. All levers have three parts
      a. fulcrum b. the part where force is used c. the part where work is done
   2. The nearer the fulcrum of the lever is to the weight, the easier the weight is to lift
   3. The lever increases the force or changes the direction of the force
   4. Do experiments: see-saw, crow-bar, prying lids from cans, scissors

- D. Inclined Planes
   1. A weight can be pushed or pulled up an inclined plane more easily than it can be lifted
   2. A wedge is two inclined planes joined together
   3. A screw is an inclined plane that winds around as it climbs

- E. Pulleys
   1. A fixed pulley can be used to change the direction of the force
   2. A movable pulley can be used to increase the force
   3. Pulleys can be combined in a block and tackle. The more movable pulleys that are used, the easier it is to move the weight

- F. Wheel and Axle
   1. When a big wheel is fastened to a small axle, a little force on the wheel will move a heavy weight attached to the axle
   2. The wheel turns the axle, which does the work
   3. The turn on the wheel gives the axle more force
   4. One wheel can turn another
      a. by connecting them with a belt
      b. by connecting them with gears
      c. a large wheel turning slowly will turn a small wheel rapidly

- G. How can we make machines work better?

II. HOW MACHINES HELP US TO DO WORK

Parts A, B, C, D, and E can probably be best handled by a separate science teaching unit

Suggested Activities

A. Field Trips

1. Either as a group or individually the children should observe as many machines as possible

B. Classroom Activities

1. Experiment to show that a machine makes work easier
2. Experiment to show how a lever works
3. Experiment to show how levers make work easier
4. Experiment to show how an inclined plane makes work easier
5. Experiment to show a wedge is two inclined planes joined together
6. A screw is an inclined plane that winds around as it climbs
7. Experiment to make a fixed pulley
8. Experiment to show how a fixed pulley is used
9. To show how a movable pulley is used
10. To show how a block and tackle make work easier

11. Experiment to make a wheel and axle machine and to show how it works.
12. Experiment to show the friction is reduced by smooth surfaces

Parts F, G, and H can be integrated with Section D of the enterprise, "How Science has Affected our Culture."

1. Friction results when two things rub against each other
2. Friction wastes energy and thus requires extra force
3. Friction is reduced by making surfaces as smooth as possible
4. Friction causes materials to wear out and to become hot
5. Friction is reduced by using oil, grease, wheels, rollers and ball bearings
6. Friction sometimes helps machines to work better
    a. car on slippery street has no friction so the wheels only spin about
    b. there must be friction to make roller skates go
    c. friction is needed for starting any motion

H. Safety
    1. Machines can be dangerous and must be used carefully

III. WHAT IS SOUND AND HOW DOES IT TRAVEL?

A. How are all sounds alike?
    1. All sound made by vibration

B. How do living things make sounds?
    1. In people and most higher animals sound is produced by vibration of vocal cords
    2. In many insects sound is made by vibration of wing parts

C. How do sounds travel?
    1. Sounds travel by vibrations in the air called sound waves
        a. sound waves travel in all directions from a thing that is vibrating
        b. sounds travel through solids, liquids and gases
        c. sound travels at about 1100 ft. per sec. in air

D. How can we control sound waves?
    1. Sound waves can be guided to travel in certain directions
        a. megaphone
    2. Sound waves can be reflected to make an echo
    3. Echoes in rooms can be prevented by using special materials on walls and ceilings

E. Why are sounds different?
    1. The highness or lowness of a sound depends upon the speed of vibration. The faster the material vibrates the higher the sound produced
        a. thin materials can vibrate faster than thick ones
        b. more tightly material is stretched, the faster it can vibrate
        c. short lengths of material can vibrate faster than long ones
    2. The loudness of the sound depends upon the force with which it vibrates
        a. how far it moves in vibrating
    3. Vibrations may be too fast or too slow for us to hear them - inaudible
        a. move hands - too slow - too low
        b. dog whistle - too fast - too high
        c. range (normal = 20-20,000 vibrations per sec.)

Suggestions

III. WHAT IS SOUND AND HOW DOES IT TRAVEL?

The section on "What is Sound and How Does It Travel?" could form the basis of a good science teaching unit

Suggested Activities

B. Classroom Experiments

1. To observe different kinds of sound makers
2. To observe that the prongs of a tuning fork vibrate when they are struck
3. To show how moving air causes vibration
4. To show that sound waves travel through the air
5. To show that sound waves travel in all directions
6. To find out whether sound travels in solid materials
7. To show that sound waves can be guided
8. To show why some sounds are high and others low
9. To show why some sounds are louder than others
10. To show how different sounds are made by musical instruments
11. To show long and short columns of air make different sounds

F. How do musical instruments make sound?
   1. All musical instruments make sounds by making air vibrate
      a. In stringed instruments, sounds are made by vibration of strings. High and low sounds vary according to length, thickness and tightness of strings
      b. In wind instruments high sound is made by vibration of a short column of air and a low sound made by vibration of long column of air

G. How our ears work
   1. We hear sounds because the sound waves travel towards our ears and make the inner parts vibrate. Nerves carry the message of the vibration to the brain which interprets them into meanings
   2. It is very important to take good care of the ears

IV. WHAT DO WE KNOW ABOUT LIGHT?

A. Where do we get light?
   1. Most of our light comes from some material that is heated till it burns
   2. Cold light - fireflies, sea animals, radium paint, etc.
   3. Many ways have been used to get light; e.g., candles, sunlight, starlight

B. How does light travel?
   1. Light travels at a tremendous speed
   2. Light travels in a straight line
   3. Light travels outward from its source in all directions

C. Why can we see things?
   1. We can see objects because they give off light or reflect light
   2. Light is reflected by most materials
      a. smooth surfaces reflect more light than rough surfaces
      b. light colored materials reflect more light than dark colored materials
      c. moonlight
   3. Light is absorbed by many materials
      a. dark colored materials absorb more light than light colored materials
   4. Light can pass through some materials but not through others
      a. opaque materials
      b. transparent materials
      c. translucent materials

D. Why can you see yourself in a mirror?
   1. An object can be seen in a mirror because light travels from the object to the mirror and is reflected back again
   2. Light travels away from the mirror on the same slant at which it strikes the mirror

E. What do lenses do to light?
   1. Light is bent when it travels through a lens
   2. The bending of light that travels from an object through a lens changes the apparent position or size of the object

IV. WHAT DO WE KNOW ABOUT LIGHT?

This topic can probably best be handled by a science teaching unit.

Suggested Activities

B. Classroom Experiments

1. To show that light travels in a straight line
2. To find out how smooth and rough surfaces reflect light
3. To show how light is reflected by a mirror
4. To show that light is bent when it passes through a lens
5. To show how light is focussed by a lens
6. To observe how a slide projector projects slides
7. To use a magnifying glass
8. To observe the outer structure of the eye
9. To observe the separation of colors when sunlight passes through a glass prism
10. To show that white is a mixture of colors

Suggestions

F. How do we see things which are small or very far away?
   1. The use of lenses can make far-away objects seem larger

G. How our eyes work
   1. Different parts of the eye work together so that we can see
   2. Too much light is dangerous, looking into sun, or an arc welder

H. Why do things have different colors?
   1. The color of an object is caused by the way in which it reflects certain light rays and absorbs others
   2. Sunlight is a mixture of light rays of many colors
   3. The colors of sunlight are separated when sunlight passes through a prism
   4. White is not a color, it is a mixture of all colors
   5. Black is not a color, it is lack of color

I. Proper lighting is important
   1. Amounts for various purposes
   2. Types of lighting, indirect, etc.

LIVING THINGS

(Detailed Outline of Concepts)

GRADE VI

HOW DO LIVING THINGS HELP AND HARM EACH OTHER AND PRODUCE THE BALANCE OF NATURE ?

1. ANIMALS

   A. Some kinds of animals, called social animals, live and work together in a colony

   B. Some animals, such as ants and aphids, are mutually helpful

   C. Some animals grow up in families

   D. Some animals join together in groups for hunting and for protection

   E. Some animals are food for other animals

   F. Plants help animals by providing food and shelter

   G. Bees and other insects carry pollen from one flower to another

   H. Birds eat destructive insects

   I. Earthworms cultivate the soil

   J. Animals scatter seeds

II. PLANTS

   A. Some plants furnish food or water for other plants

   B. Some plants furnish shade and protection for other plants

   C. Some plants climb on others to reach sunlight

   D. Decayed plants enrich the soil and thus help other plants

   E. Some plants are poisonous to animals

   F. Plants such as fungi destroy other plants

   G. Some plants capture animals for food

   H. Some kinds of plants (bacteria) cause disease in other plants and in animals

   I. Stronger plants take water, food materials, and sunlight from weaker ones

III. PLANTS AND ANIMALS

   A. Animals use either plants or other animals for food

GRADE VI

Suggestions

HOW DO LIVING THINGS HELP AND HARM EACH OTHER AND PRODUCE THE BALANCE OF NATURE ?

General: This unit should be developed so as to emphasize the balance of nature. The teacher should bring about the realization that plants and animals live in an environment of mutual dependence. Pupils of this age will be interested in the population cycles of local animals, (e.g. mice, rabbits, coyotes, Hungarian partridge, etc.). When any animal population increases to a marked degree so also does the population of its natural predators. This process is accompanied by an ever-increasing tendency for the predator population to become so large as to decrease the population of the prey to the critical point where the numbers of both go into a rapid decline

Integrations: This unit does not lend itself easily to enterprise integration, and should, therefore, be developed as a separate science teaching unit. It might be developed as a parallel activity following upon the motivations of the study of "What is the History of Living Things."

Suggested Activities

1. Field Trips

Depending upon the locality, field trips might be used to good advantage to observe:

A. social animals (e.g. beavers, apiaries)
B. mutually helpful animals(e.g. ants and aphids)
C. beneficial animals (e.g. earthworms, bees)
D. helpful birds (e.g. hawks and owls)
E. mutually helpful plants (e.g. wood-violets in shade, vines, fungi)

2. Classroom Observation Devices

A. build an ant colony
B. build an aquarium
C. build a terrarium

B. Insects are great enemies of plants and other animals

C. All our food comes directly or indirectly from plants

D. We use plants for clothing, wood, rubber, medicine, etc.

E. Plants hold the soil in place and thus help prevent floods and dust storms

F. Food, clothing, and other products come from animals

G. Some animals protect us or do work for us

H. Some animals destroy plant and animal pests

I. We raise and take care of plants and animals on farms

J. Some plants and animals have adaptations for protection and shelter

WHAT IS THE HISTORY OF LIVING THINGS?

A. What were living things like long ago?
   1. The earth is very old
   2. Living things have changed
   3. New living things are appearing and others disappearing

B. How do we know what living things were like long ago?
   1. Fossils tell us
   2. There are several kinds of fossils:
      a. petrification (plants and animals)
      b. impressions (plants and animals)
      c. casts (plants and animals)
      d. encasement (in tar, amber, ice)

C. What do fossils tell us?
   1. Fossils show changes in:
      a. earth's surface
      b. climate
      c. living things

D. How have animals and plants changed?
   1. Fossils show development from simple to complex forms

E. Why have some plants and animals continued to live on the earth while others have died ?
   1. Changes in the earth's surface and climate make it necessary for living things to:
      a. adapt, or
      b. move, or
      c. die

3. Skill Building

This unit lends itself to giving pupil practice in summarizing, note making, outlining and oral reporting from those outlines. The whole unit may be very profitably developed along these lines, and can serve as a preparation for further enterprise report work.

WHAT IS THE HISTORY OF LIVING THINGS ?

Integration:

a. This unit can easily be integrated into enterprise Section A ("How Man Has Lived and Worked Through the Ages"). In this case it would serve as an introduction to the social and economic history of man. Naturally this applies only in the event that Section A is organized as a study of man's development from one cultural stage to another, beginning with earliest man. (In doing this it is suggested that to study the whole of man's development, from earliest times to the present, is too complex a study under ordinary conditions. Thus the teacher might best limit the study of man to the period from earliest man to the beginnings of urban civilization - Egypt and Babylon, etc. See "Possible Organization of the Year's Science Program.")

b. This unit might also be integrated into enterprise Section B ("How Men Live and Work in Canada Today".) In this case it would more than likely be developed as a parallel activity initiated by the study of Alberta's physical features and the oil and coal industries. (The June, 1955 issue of "Maclean's" magazine makes a good teacher reference here).

Suggested Activities

1. Field Trips

    A. If possible, pupils should be permitted to see fossils or fossil formations
    B. Visit a museum

2. Collections

    A. Build up a collection of your own pictures and fossils

THE EARTH AND THE UNIVERSE

(Detailed Outline of Concepts)

GRADE VI

1. WHAT IS THE UNIVERSE LIKE ?

A. Solar System
  1. We could not live without the sun. Without it we would not have:
    a. any heat
    b. any light
    c. any food
    d. any energy
  2. The sun is the center of our solar system which contains:
    a. nine known planets
    b. the planetoids
    c. satelites
  3. The planets vary in size, distance from the sun, speed of revolution and number of moons
  4. Each of these revolves around the sun in a fixed path called an orbit
  5. Each planet at the same time rotates on its axis
  6. Planets are held to their orbit by opposing forces
  7. The movements of the solar system are regular and exactly predictable
  8. There is no proof of the existence of life on any planet but the earth

B. What are Comets ?
  1. Comets are made up of gases and little bits of solids
  2. The orbits of comets and planets often cross

C. What Causes an Eclipse ?
  1. An eclipse of the sun is caused by the moon passing between the earth and the sun
  2. An eclipse of the moon is caused by the earth passing between the moon and the sun

D. What is Beyond the Solar System ?
  1. Beyond our solar system are uncounted numbers of suns (stars) and perhaps other solar systems
  2. Distances between stars are so vast that scientists measure them in light years
  3. A light year is the distance that light travels in one year

E. The Birth of Our Earth
  1. Theories re the formation of the earth
  2. Ice-ages
  3. Forces of erosion) the process of building up and
  4. Mountain building) tearing down
  5. Layers of the earth
  6. Formation of soil

THE EARTH AND THE UNIVERSE

GRADE VI

Suggestions

1. WHAT IS THE UNIVERSE LIKE ?

Integrations: See "Possible Organization of the Year's Science Program."

Suggested Activities:

1. Field Trips
    - A. Plan a "star-party", or somehow motivate pupils' observation of the constellations
    - B. Visit university observatory
2. Experiments

    To Show:
    - A. Why the earth stays in its orbit
    - B. How the moon can cause an eclipse of the sun
    - C. Day and night
    - D. Roundness of the earth
    - E. Motion of the earth
    - F. Erosion
    - G. Seasons and angles of light rays

ENERGY AND MACHINES

(Detailed Outline of Concepts)

GRADE VI

I. ELECTRICITY: PRODUCTION AND CONTROL

A. Where Does Electric Current Come From?
   1. Electric current can be produced by chemical change in a dry cell or a wet cell - diagrams. Explain workings except for actual chemical reactions
   2. Electric current can be produced by generators that use the energy of moving water, steam, wind, or exploding gas. Diagrams generators and turbines - Explain that electricity comes from wire turning in magnetic field - but don't go into why this is so

B. Frictional Electricity (called Static)
   1. Simple kinds
      a. hair
      b. rubbing
   2. Lightning
      a. produced by friction of air, dust and water particles
      b. lightning rods - fact and fiction about protection from lightning
   3. Trucks and airplanes build up static electricity

C. How Electric Current Flows
   1. Electric current will flow only when there is a closed circuit
   2. Proper use of electrical appliances to avoid danger
   3. Light bulbs and sockets work - diagrams. How neon and fluorescent lights work

D. Why Are Electric Wires Covered?
   1. Electric current always follows the shortest possible path
      a. cause of short circuit
      b. result of short circuit
      c. prevention of short circuit - fuses - circuit breakers
      d. how to splice a wire
      e. how to fix a plug
      f. how to re-tape a wire
   2. Electric current flows easily through materials called conductors but not through non-conductors or insulators
   3. Electric wires are extremely dangerous if not properly insulated

E. How Do We Control Electric Current?
   1. Electric current can be turned on or off by opening or closing the circuit with switches
   2. Electric current can be made stronger or weaker by using a transformer or more cells

F. How Do We Use Electric Current to Produce Heat
   1. When electric current goes through a wire that is a poor conductor the wire becomes hot

GRADE VI

Suggestions

I. ELECTRICITY: PRODUCTION AND CONTROL

Integrations: This unit can be integrated with enterprise Section D ("How Science Has Affected Our Industries"). Section D is intended to emphasize the social and economic implications of technical advancement in industry. Nevertheless, such a unit as "Electricity: Production and Control" could well form part of a technical study of industrial advancement which would introduce and form a basis for a social and economic study. See "Possible Organization of the Year's Science Program."

Suggested Activities:

1. Field Trips
   - A. Visit a generating plant
   - B. Visit a telegraph office
   - C. Visit a telephone exchange
   - D. Inspect electrical systems in the school

2. Experiments and Demonstrations:
   - A. Find out what is inside a dry cell
   - B. Make a wet cell and show how it works
   - C. Show that electricity flows only in a closed circuit
   - D. Observe the circuit in an electric cord
   - E. Find out what a short circuit is
   - F. Show why wires are insulated
   - G. Show that wires are heated when a short circuit takes place
   - H. Show how a fuse works
   - I. Show how a push button works
   - J. Find out how an electric current is changed to heat
   - K. Observe the heating element in an electric iron
   - L. Make an electro-magnet
   - M. See what an electro-magnet will attract
   - N. See how the force of an electro-magnet can be controlled

G. How Does Electric Current Give Us Light?
  1. When an electric current goes through a poor conductor, the conductor becomes so hot it gives off light
  2. Some light is made with gases that glow when electric current flows through them

H. How Can We Use Electric Current to Make a Magnet?
  1. Electric current can be used to make a magnet
    a. an electro-magnet is made when an electric current flows through a wire wound around a piece of iron or steel
  2. An electro-magnet can make things move - e.g. motors

I. How Does a Telegraph Work?
  1. In a telegraph or other electrical device, the part moved by an electro-magnet is called the armature
  2. The movement of the armature is controlled by the opening and closing of the circuit

J. How Does An Electric Bell Ring?
  1. The spring and contact point open and close the circuit as the armature moves back and forth
  2. The bell keeps ringing as long as the circuit is closed

K. How Does An Electric Motor Run?
  1. An electro-magnet has two poles just as other magnets do
  2. An electric motor runs as the poles of an electro-magnet are first attracted and then repelled by the poles of another magnet

II. EFFECT OF HEAT AND COLD ON MATERIALS

A. Heat Travels
  1. Some things conduct heat better than others - air, metal wood, etc.
  2. Insulation uses this knowledge

B. How Do Heating and Cooling Change the Size of Solids ?
  1. Heating makes most solids expand or get larger
  2. Cooling makes most solids contract or get smaller

C. What Happens to Liquids when they are Heated or Cooled ?
  1. Heating makes most liquids expand
  2. Cooling makes most liquids contract
  3. When liquids expand they become lighter
  4. Warm water is pushed upward by the colder, heavier water, which sinks

D. How is Hot Water Used to Heat a House ?
  1. Hot Water can be used to heat houses

E. How Do Heating and Cooling Change Gases ?
  1. Gases expand when heated
  2. Gases contract when cooled
  3. Gases become lighter when they expand
  4. Cold air sinks and pushes warm air upward

O. Find out how the force of an electro-magnet is made stronger
P. Make a telegraph set and find out how it works
Q. Find out how an electric bell works
R. Find out whether an electro-magnet has a north and south pole
S. See how an electro-magnet can turn a motor
T. Observe how a motor runs
U. Make a simple telephone
V. Find out why carbon is used in a simple transmitter

II. EFFECT OF HEAT AND COLD ON MATERIALS

Integrations:

a. This unit may best be handled in a survey fashion as a part of unit II-A("What is the Universe Like"). In this case it is used as a basis for explaining the cooling of the earth, erosion, etc. in part E of II-A. As is pointed out in "Possible Organization of the Year's Science Program", this all might form part of larger enterprises

b. This unit might also form part of enterprise Section C ("How We Control Global Patterns"), used as a basis for explaining the causes of air and ocean currents

Suggested Activities:

1. Field Trips:

A. Visit School's heating plant
B. Visit area showing how water has eroded rock

2. Experiments:

A. Find out what heat does to solids
B. Find out what happens to liquid when it is heated and cooled
C. Show that variance of heat expands and contracts air
D. Show that air has weight
E. Show how air currents are caused

F. How Does a Hot Air Furnace Work?
   1. Hot air can be used to heat a house

G. How are Solids Changed to Liquids?
   1. Different solids melt at different temperatures
   2. The temperature at which a solid melts is called its melting point
   3. Ability to make alloys and shape metals

H. How Are Liquids Changed to Gases?
   1. When a liquid boils, it changes to a gas
   2. Different liquids boil at different temperatures
   3. The temperature at which a liquid boils is called its boiling point
   4. A liquid does not get any hotter than its boiling point

I. How is Water Vapor Changed to Liquid Water?
   1. Gases change to liquid or condense when they are cooled
   2. Water vapor in the air condenses if the air is cooled enough

J. All Materials Are Either Solid, Liquid, or Gas
   1. Materials change their form with sufficient change in temperature; e.g., water, carbon dioxide, iron, etc.

II. WHAT ARE THINGS MADE OF?

A. How Are Materials Different From Each Other?
   1. Every kind of material has its own characteristics
   2. The use of a material depends on its characteristics

B. How Can We Change the Characteristics of Materials?
   1. Physical change is a change of characteristics without making a new material
   2. Chemical change is a change of characteristics in which an entirely new material is produced

C. What are Elements?
   1. Everything in the world is made of elements
   2. An element is the simplest kind of material; it is made only of itself
   3. There are 98 known elements
   4. Elements can be solids, liquids or gases

D. What are Compounds?
   1. Elements combine in chemical change to make compounds
   2. These compounds are an entirely new material
   3. There are a large number of compounds

E. What are Molecules?
   1. The smallest possible particle of any substance is a molecule
   2. Each kind of element and each kind of compound consists of only one kind of molecule
   3. How we see molecules (electron microscopes)
   4. Molecules move (evaporation, osmosis, etc.)
   5. Heat makes molecules move faster

F. Find out if air is warmer near the ceiling
G. Show how air currents move in a room
H. Observe that different solids have different melting points
I. Find the melting point of ice
J. Show that heat makes liquids evaporate faster
K. Show that some liquids evaporate faster than others
L. Use ice to show H_2O passing through the three physical stages of solid, liquid and gas. (Point out that all materials can be passed through these stages by variance of heat)

III. WHAT ARE THINGS MADE OF?

Integrations:

This unit is, perhaps, best taught as a separate science unit. It does, however, have obvious relations which suit it well to a parallel activity motivated at such places as in enterprise Section D ("How Science Has Affected Our Industries"), in the study of how the earth was formed in science unit B-I("The Earth and the Universe"). "Possible Organization of the Year's Science Program" suggests where this unit might be fitted in. The children can become very fascinated with this unit - especially if they are allowed to perform experiments themselves.

Suggested Activities:

1. Experiments:

A. Observe the characteristics of materials
B. Show that litmus paper is an acid indicator
C. Show chemical change in starch
D. Show chemical change by heating sugar
E. Show the difference between a mixture and a compound

F. How Do We Use Chemical Changes?
   1. We use chemical changes to produce new material and heat

G. Prevention of Harmful Chemical Changes
   1. Harmful chemical changes can be prevented by:
      a. keeping the elements apart
      b. keeping some materials dry
      c. keeping some materials cool
      d. keeping some materials out of the light

H. Interesting Facts About Elements
   1. Oxygen
      a. most plentiful - in compounds and mixtures
   2. Hydrogen
      a. lightest element
   3. Helium
      a. won't compound
      b. won't burn
   4. Mercury
   5. Carbon and CO_2
   6. The Story of Radium
      a. the Curies   b. radioactivity
      c. atom bombs
   7. New compounds
      a. plastics   b. sulfa drugs
      c. dyes   d. fuels

IV. HOW DO WE CONTROL FIRE?

A. Materials to Make a Fire
   1. We need these three things to make a fire:
      a. combustible material
      b. enough heat to raise the material to its kindling temperature
      c. air near the material
   2. Heat to start a fire may be produced with friction
   3. Matches help us light fires easily, but they must be used with care

B. What Happens When Things Burn?
   1. When any material burns, it gives off heat and light and becomes smaller
   2. When any material burns a chemical change takes place
      a. Carbon contained in material combines with oxygen to form carbon dioxide
      b. Hydrogen contained in material combines with oxygen to form water
      c. Minerals are left as ashes
      d. If enough oxygen is not present the carbon remains uncombined as smoke

C. How Can We Conserve Our Fuels?
   1. We must conserve our coal, oil, gas, etc. because these supplies won't last forever and cannot be replaced
   2. Fuels may be conserved by using them carefully
   3. Fuels may be conserved by using new kinds of fuels or other sources of energy

F. Show that moisture brings about the rusting of iron
G. Produce a chemical change by adding water to baking powder
H. Produce a chemical change by heating sulfur and powdered iron

2. Displays:

Make displays showing: examples of elements and compounds, elements which make compounds (e.g. the compound sugar is composed of the elements carbon, hydrogen and oxygen), safety rules for experiments, pictures of compounds in industry, physical changes as compared to chemical changes, etc.

IV. HOW DO WE CONTROL FIRES?

Integrations:

a. This unit might be handled as a separate science unit. Done as a quick survey it would be very appropriate during fire-prevention week.
b. It could be integrated with a study of Canada's forest industries under the enterprise, "How Men Live and Work in Canada Today."

Suggested Activities:

1. Field Trips:

A. Visit local fire station
B. If possible, visit forest-ranger station
C. Examine school fire alarm and fire fighting apparatus

2. Experiments:

A. Show that a fire must have air in order to burn
B. Show that materials need oxygen in order to burn
C. Show what happens when a candle burns
D. Show that carbon-dioxide is formed by burning
E. Show that water is formed by burning

D. What Can We Do to Prevent Fires?
    1. Accidental fires can be avoided by preventing the three things needed for burning from coming together

E. How Can We Put Out Fires?
    1. Fires should be reported to the fire department promptly
    2. Fires can be put out be removing one or more of the things needed for burning